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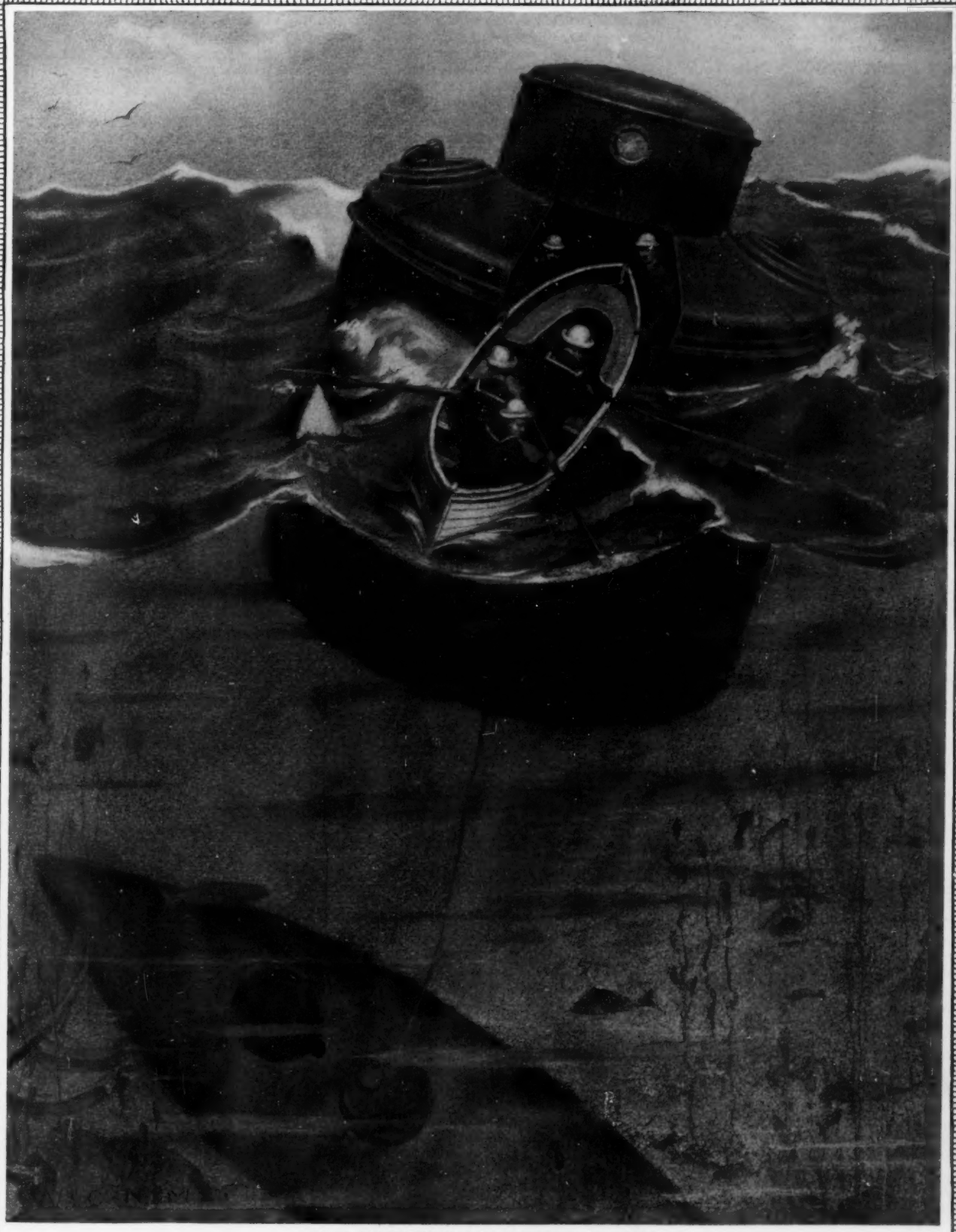

SAVING MEN FROM A SUNKEN SUBMARINE

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Valuable Data for the Aeroplane Builder

THERE can be no doubt that the excellent progress which is being made in Great Britain in practical aeronautics is in great measure due to the experimental work which has been done at the National Physical Laboratory for the Advisory Committee for Aeronautics. The extent and detail of the work of the committee may be judged from its fourth annual report, which contains more than four hundred pages, and embodies no less than twenty-eight separate reports. Limitations of space prevent any elaborate review of this work, and we shall merely attempt, here, to sum up the more important findings.

From the report on experiments with models of aeroplane wings we learn that good results will be secured by placing the maximum ordinate of the wing section farther from the front edge than is the present practice. Furthermore, so far as the aerodynamics of the wings are concerned, there is nothing to be gained by thickening the leading edge, although there is no particular disadvantage if the edge is moderately thickened. Of considerable constructional advantage is the fact that a distinct increase may be made in the thickness of the after portion of the wing, without incurring any aerodynamical disadvantage. The value of this fact is that transverse spars of deeper section than are commonly used may be inserted toward the trailing edge of the wing. On the question as to how far results obtained with models may be applied to full-size wings, we learn that the lift-drift ratios of models should be increased from 15 to 20 per cent to make them reliably applicable to full-size wings.

A question which has attracted much attention of late years is that of the value of reflexing the trailing edge of the wings, and it has been established that to restrict or entirely prevent the movement of the center of pressure, when there is a change in the angle of incidence, it is necessary to reverse the curvature in the after portion of the wings. The laboratory tests have shown that absolutely to prevent the movement of the center of pressure in this way, about 12 per cent of the maximum lift-drift ratio must be sacrificed, and of the maximum lift coefficient about 25 per cent.

The report on the distribution of pressure over the surface of the wings brings out the fact that the tips of the wings have a very low aerodynamic efficiency. Good results, according to the report, should follow a careful investigation into the effect of variations of camber, angle of incidence, and plan form in that portion of the wings at and near the tips.

The report dealing with wind forces and moments shows that great accuracy is necessary in giving the struts symmetrical form. If they are not symmetrical, highly unsymmetrical and erratic cross-wind forces will be produced by the struts when the aeroplane yaws from its path. If the struts have a large ratio of fineness, irregularities of construction will have a small effect on the drift and the transverse wind forces. Should the ratio be less than 2½ to 1, the drift will be extremely high, and the transverse wind force will be erratic in its magnitude.

The tests on model aeroplane bodies show that good results are to be expected from giving careful attention to the design of the body. To many aeroplane builders it will be a surprise to learn that, in place of the symmetrical torpedo body form, better results are to be expected if a single boom is extended from the cockpit to the tail planes and elevators.

Tests on a model tail plane and elevator planes prove that the maximum control is reached when the elevators are turned to an angle of 30 degrees, above or below the horizontal; furthermore, the elevating or depressing moments are about proportional to the angle of depression or elevation, until the above-mentioned limiting angle of 30 degrees plus or minus is reached.

Of widespread interest will be the results obtained in the investigations of the gyroscopic action of the engine and propeller. If an aeroplane driven by a 100 horse-power Gnôme engine coupled to a 9-foot 6-inch, 2-bladed, 30-pound propeller, is caused to make a complete turn in 20 seconds, the total gyroscopic couple is found to amount to 324 foot-pounds; and a sudden manipulation of the elevator to an extent just sufficient to raise the pilot from his seat, was found to be 330 foot-pounds. According to the report, these couples are not of serious amount and they can readily be met by the ordinary controls. They act upon the aeroplane in much the same way as a gust of wind; but there is the advantage that both the magnitude and the direction of the gyroscopic couples are known and the pilot is prepared for them.

The report on model propellers endorses the present method of design in determining their section, etc. Under the present method each section of the blade is considered as a small aerofoil, and is designed accordingly. The report shows that the method is not strictly correct, and that the calculated thrust, torque, and efficiency are slightly less than that obtained by the accepted method. The laboratory experiments proved that a certain type of propeller should have had a maximum efficiency when the angle of attack was 4 degrees. This efficiency, however, was not reached until the angle had been raised to 9 degrees.

"Boats for All" a Failure

GRADUALLY, but very surely, it is coming to be realized that the only way to safeguard the lives of passengers at sea is so to build the ship which carries them that it shall act, in case of necessity, as its own lifeboat—in other words, to make the construction such that no accident could send it to the bottom with the suddenness which marked the sinking of the "Empress of Ireland."

The principle of safeguarding the passengers by providing boats for all is faulty, for the reason that it assumes that certain conditions of wind, weather, and time, all of which must be present if the boats are to be launched, will exist when the emergency calls for their immediate use. In the case of the "Titanic," these conditions fortunately happened to exist. There was no wind, the sea was calm, and the two hours and twenty minutes from the collision to the sinking of the ship provided sufficient time to utilize practically all the boats that the ship carried. In the case of the "Empress of Ireland," however, although there was no wind and the sea was calm, and although there were more than sufficient boats to carry everyone on board, the ship listed so heavily, and went under so quickly, that only a very few of the boats were got into the water.

It is gratifying to note that the *Engineer* of London, an organ of very high authority in maritime matters, has come to our point of view in this most serious question. In its issue of June 5th, in discussing the recent disaster, it says: "One cannot help reflecting that here, again, as in the case of the 'Volturno,' the principle of 'boats for all' has signally failed. The 'Empress' could have carried every soul on board in her boats, but she had no chance to use them." On another important phase of this question, the *Engineer* is in agreement with us; for farther on in the same article it says: "The 'Empress of Ireland' was built by Fairfields, in 1906, on lines that were considered the best before the loss of the 'Titanic.' She had an extensive double bottom, and was well divided, *but she had no inner skin.* (The italics are ours.) Whether an inner skin would have saved her, under the circumstances of the collision, is a question which the evidence of the divers may help to answer. . . . But there seems to have been no question of cutting her in two. The effect, from the meager evidence we have, seems rather to indicate that the plates were ripped off by the bow of the 'Storstad,' as we rip the lid off a box with a screwdriver. If the divers can substantiate this view, a very strong case for the double inner skin will be presented. For it is probable that while many ribs would, of necessity, have been badly distorted, yet the inner hull might have held, at least for a time."

We attach the more importance to this admission on the part of our contemporary, for the reason that its attitude at the time of the "Titanic" disaster was rather unfavorable than otherwise to inner skin construction. The only valid objection against the inner skin, particularly if it consists of the inner walls of coal bunkers, is that the inflow of water is confined to one side of the vessel, and that heavy heeling, which might become disastrous, would be occasioned. The answer to this is that, if provision were made for flooding the corresponding compartments on the opposite side of the ship, it would be possible to maintain her equilibrium by quickly admitting sufficient water for the purpose. Battleships are built on this principle, and there is no constructional difficulty which would prevent its being applied effectively to large passenger-carrying ships.

There is yet ample time for the consideration of amendments to the convention drawn up in London, last Winter, by the International Conference on Safety at Sea. The insertion of a clause, rendering the use of some form of inner skin on the large passenger-carrying ships, not, as it is at present, optional, but strictly obligatory, would round out and complete the otherwise excellent work of that congress.

As these words are being written, there comes the startling information that, for the third time in less than a month, a transatlantic liner has been run into by another ship. A little over two weeks after the loss of the "Empress of Ireland," the "New York" was rammed by the "Pretoria"; and a few days later, the "Kaiser Wilhelm II," while crossing the English Channel, was struck squarely amidships by another vessel. Both ships, fortunately, are subdivided far more effectively than the avearge ocean liner—the "New York" having closely-spaced transverse bulkheads, carried to an unusual height above water, and the "Kaiser Wilhelm II" carrying a continuous inner skin throughout the engine and boiler-room spaces. The "Kaiser" reports that water gained admission only to one compartment, probably a side bunker of small capacity. Had she been built as are 95 per cent of the passenger ships, the water would have had free access to the whole width of the ship.

Evolution and Physical Law

THE division of human knowledge into separate fields of science is more or less arbitrary, and chiefly due to certain peculiarities of our senses. It is therefore to be expected that the most fundamental principles of science shall be of universal application, and shall be found to hold, in some form or other, in widely separated branches of science.

In the biological sciences, one of the most fundamental principles is that of evolution by the survival of the fittest. What is there corresponding to this in the purely physical sciences?

Evolution, as understood by the biologist, is an essentially one-directional process in time, an advance or development, to use expressions which are illustrative rather than precise.

Now the physicist is acquainted with two kinds of processes. There are purely mechanical processes. A peculiar property of these is that in them time does not enter in a one-directional way. It can be shown that if all the motions of a purely mechanical system were instantly reversed, it would exactly retrace its history. There is thus nothing unique in the actual history of a purely mechanical system.

But in all other systems, and that is to say all *real* systems, which are not purely mechanical, there is dissipation of energy through degradation of other forms into heat, and through passage of heat from higher to lower temperatures. In such a system the one-directional character of time is again apparent and finds its exact expression in the second law of thermodynamics. This law can be stated in various forms. For purposes of a popular exposition, it is perhaps best presented in some such terms as these: Heat cannot, of itself and spontaneously, i. e., without compensating change of some kind, pass from a colder to a hotter body.

The more technical statement of the law is to the effect that the *entropy* of an isolated system can only increase, not decrease, with time. Or in other words, the entropy of such a system tends toward a maximum.

Now there are certain systems, as for example a system comprising several substances undergoing chemical reaction, the history of which can be forecast by application of the entropy principle alone. The system will ultimately reach a state of equilibrium in which the entropy will be a maximum. The entropy principle in such a case is *the law of evolution.*

In the case of the highly complex system presented to us by the living world, this statement alone, though it may be correct, fails to carry all the information which the biologist seeks. Still, here also, we know, evolution is a one-directional process, and it may reasonably be expected that the law of evolution takes a form similar to that of the second law of thermodynamics. Some function of the state of the system tends toward a maximum. But what is that function? This is a problem which remains to be solved.

A Wireless Receiving Installation now in use at the Duomo, in Florence, is interesting for the fact that the entire outfit, including the antennæ, is inside the cathedral. Messages received from points as far distant as Paris, Madrid, and Toulon indicate that the apparatus is hardly less efficient than if installed out of doors.

Engineering

Hydro-Electric Power from the Assuan Dam.—It seems that the rumor that Mr. Hugh L. Cooper, who designed and built the Keokuk Dam on the Mississippi, has been appointed by the Egyptian Government to take charge of the work of building two great dams south of Khartoum on the Nile, at the cost of $20,000,000, is incorrect. Mr. Cooper states that the report must have grown out of the fact that, at the request of the Egyptian Government, he submitted plans for the development of power at the Assuan Dam.

The Life of Locomotives and Passenger Cars.—It is estimated by the Pennsylvania Company that passenger cars and locomotives have a useful life of 20 years, at the end of which time their value as scrap will be only about 20 per cent of their original cost. An allowance of 3 per cent for depreciation and renewal is made for freight cars and of 4 per cent for locomotive and passenger cars. Because of the absence of sufficiently lengthy experience in steel cars, an allowance of 4 per cent is made for depreciation and renewal. This seems to us to be a very conservative estimate.

Submarine Bells on Lifeboats.—After the burning of the transatlantic steamship "Columbia," one of the boats drifted for no less than two weeks in the path of transatlantic liners; but although the wrecked seamen saw several steamers, they could not attract their attention by signals. Of the 15 men in the boat, 11 died before the boat was sighted. Had the lifeboat carried a submarine bell, it could have signaled Atlantic steamers which were similarly equipped, even at a distance of several miles. The suggestion is well worth careful consideration.

Fewer Rail Failures in New York State.—Thanks to better sections and better materials, there has been a great improvement in the quality of rails laid throughout this State during the past three years. Thus, in the three months, January, February and March, there were in 1912, 3,580 rail failures, the large number being due mainly to the severe Winter. In the same three months in 1913, when the weather was mild, the rail failures were only 1,122. But for the same three months in 1914 when the weather was nearly as bad as in 1912, there were only 1,724 rail failures, a most encouraging showing.

Another Fifteen-Cubic-Yard Dredge for the Panama Canal.—In our issue of May 9th, we illustrated the "Gamboa," the largest dipper-dredge ever built, which is now doing good work on the Cucuracha slide in the Culebra Cut, Panama Canal. This dredge, built by the Bucyrus Company, South Milwaukee, Wisconsin, especially for the Panama Canal, has a dipper of 15 cubic yards capacity. The second of the dredges, the "Paraiso," built by the same company and a duplicate of the "Gamboa," left New York Harbor in tow on April 26th, and will very soon be at work with the sister dredge, cleaning up what remains of the great slide.

Panama Canal Built Within Estimates of Unit Costs.—The engineers of the Panama Canal must be congratulated on the fact that they have built the canal within the original estimates of unit costs—something very rare in work of this magnitude. The estimate of cost of dry excavation for the Culebra cut was 80 cents per cubic yard, and it was actually built at a cost of 78.18 cents. The estimate of $8 per cubic yard for concrete in the locks was also above the actual cost, which was $7.14 per yard at Gatun, $5.89 at Pedro Miguel, and $5.37 at the Miraflores locks. Dredging in the harbors and entrances was estimated at 25 cents per cubic yard. The actual cost was 23.25 to 25.52 cents per cubic yard.

Trial Trip of the Largest Freight Locomotive.—The "Matt H. Shay," the large triple Mallet locomotive, built by the Baldwin Locomotive Works for the Erie Railroad, and recently illustrated in this journal, has made a trial trip over the Baltimore & Ohio Railroad from Baltimore to Philadelphia. The train load consisted of 55 coal cars carrying 4,012 tons of coal. The total weight of the whole train, including the locomotive, must have been about 6,500 tons. The train left Baltimore at 6:10 in the morning and reached Philadelphia at 4:30 in the afternoon, taking 10 hours and 20 minutes for the 98-mile trip. The engine weighs 423½ tons in working order, and its drawbar pull, working compound, is 80 American tons.

Successful Automatic Train Stop.—Six months of operation of the Miller automatic train stop on 24 miles of the Chicago & Eastern Illinois Railroad is reported. The system has been in place on one of two tracks on the section of the road in question, and 90 freight and passenger locomotives have been equipped with the necessary apparatus. On other sections of the road, some 20 miles have been equipped, and will be put in operation. The system includes a vertically-moving bar on the engine and a ramp on the roadway. Operation was carried on under severe conditions of sleet and snow, and the records show instances of "safety failure," in which without exception the apparatus brought the train to a stop when the block was occupied and the signal was set at stop.

Science

$35,000,000 for Science.—A great hospital and medical school for St. Louis University is provided for in the will of James Campbell, filed in the Probate Court at St. Louis on June 16th last. The entire estate, valued at between $35,000,000 and $40,000,000, with the exception of $1,000,000, eventually goes to the university "for a hospital for the care of sick and injured persons," and the "promotion of the sciences of medicine and surgery."

Elaborate Scientific Investigations in Porto Rico, covering a period of four years, have been undertaken by the New York Academy of Sciences, with the financial co-operation of the American Museum of Natural History, the New York Botanical Garden, Columbia University, New York University, and the government of Porto Rico, and under the direction of a committee consisting of Profs. N. L. Britton, James F. Kemp, Franz Boas, C. L. Poor, and H. E. Crampton. The programme includes studies in anthropology, archæology, botany, zoology, geology, oceanography, etc. The reforestation of certain parts of the island is one of the practical problems to be investigated.

Relief Model of Hawaiian Craters.—A remarkable relief model of the craters of Kilauea, Kilauea-Iki and Keanakakoi, in Hawaii, has been made by George Carroll Curtis, of Boston, for the Harvard University Museum, to which it is a gift from Robert Sayles, curator of geology. Mr. Curtis spent three months in making a photographic survey of the region, establishing a network of flag stations and photographing from all of them. He states that this was "probably the most comprehensive survey of its kind yet made for the reproduction of a land-form type." It is expected that a copy of the model will be exhibited in the Hawaiian building of the Panama-Pacific Exposition.

The Windiest Region of the World of which we have any knowledge appears to be the coast of Wilkes Land, where Dr. Mawson's expedition recently spent two years. In his presidential address before the Royal Society of New South Wales, Mr. R. H. Cambage recently stated that Mawson's records at Adélie Land for 1912 showed an average wind velocity throughout the year of about 48 miles an hour, while velocities of 100 miles an hour were common. This surpasses even the records made on high mountains in other parts of the world; e. g., on Mount Washington, N. H., where the former meteorological station showed an average velocity of only 41 miles an hour during the Winter, and much lower velocities in Summer.

A Barometer Graduated in C. G. S. Units.—A well-known firm of instrument-makers in London has put on the market a new form of aneroid barometer, which was designed under the direction of Dr. W. N. Shaw, the head of the British Meteorological Office. The new instrument has several concentric scales. The outer is figured in centibars and subdivided to millibars. This scale can be adjusted according to the altitude of the place of observation, and then gives sea-level readings, such as are used for many purposes in meteorology. Along this scale is engraved the new nomenclature, "very low," "low," "normal," "high," "very high," in place of the time-honored but misleading terms "fair," "change," "rain," etc., which appear on nearly all existing barometers except those constructed strictly for scientific use. The frequency of occurrence of various readings, in days per year, at three representative English observatories, is also engraved on the scale, so that the observer can tell just how a reading compares with average conditions. The next inner dial is also in the centibar scale, but is fixed, and therefore gives the actual value of the pressure, unreduced for altitude. Lastly, two more scales give readings in inches and millimeters.

Ammonia and Nitrate in Rain.—Plant physiologists once believed with Liebig that a considerable part of the nitrogen utilized in the nutrition of plants was obtained from rain. Although this view has been abandoned, the amount of ammonia and nitrate in rain water has remained a favorite subject of investigation, and a great number of analyses have been made in various parts of the world. These have been brought together by Dr. N. H. J. Miller, in an article on "The Composition of Rain Water Collected in the Hebrides and in Iceland," published in the *Journal* of the Scottish Meteorological Society. The principal object of Dr. Miller's inquiry is to ascertain from what source these nitrogenous components of rain are derived. The old idea of Boussingault that atmospheric ammonia is derived from the sea, and the later one of Schloesing that tropical seas yield ammonia to the air, appear to be refuted by the fact that analyses of rain collected near the sea in tropical countries show less ammonia than is found at Rothamsted. Samples of rain collected systematically from various stations in the Hebrides and in Iceland, remote from sources of atmospheric pollution, contain ammonia and nitrate, but in very small amounts; in fact, the rain at the Butt of Lewis, in the Hebrides, contains less ammonia than at any other place in the world at which samples have been taken, being even less than was found in the Antarctic by the Charcot expedition.

Automobile

Eliminating Glare from Headlights.—Still another solution of the troublesome problem of eliminating the confusing and dangerous glare from high power motor car headlights has been proposed, this time by the National Physical Laboratory of England. This body has been studying the question at the request of the London authorities. It proposes, briefly, to cut off the light beams coming from the upper right hand corners of the lamps, and in this way to provide a zone of darkness, if such it may be termed, so that an approaching driver will not be blinded. The right hand corner is chosen for the reason that in England the rule of the road is to the left. The arrangement provides ample light, yet appears to solve the glare problem.

A New Type of Differential Mechanism.—The motor car differential, that more or less weird mechanism which few but engineers really understand, always has constituted a knotty problem. By way of assuring that both rear wheels will rotate at the same speed on a straight road, regardless of traction obtainable at each, an inventor has perfected a new mechanism which differs from others principally in that it incorporates a plate clutch. The two plates of the clutch are connected one to either side of the divided rear axle and are held together by a spring. Thus when the car is traversing a straight road, the two halves of the axle must rotate at the same speed, for they are virtually locked together. But when the vehicle rounds a curve the clutch slips, permitting one of the rear wheels to rotate faster than the other. Obviously the mechanism has faults, for there must be considerable wear in the clutch; but the device indicates that attention is being given this problem.

Comprehensive Fuel Economy Test.—Tests of the fuel economy of motor cars by factories have not always been as convincing to the lay public as might be desirable to those who make the tests. Recently, however, the Franklin was subjected to a combination test and demonstration that cannot fail to prove convincing. Ninety-four dealers in Franklin cars, located in as many American cities, each fitted one of his six-cylinder cars with a tank containing one gallon of gasoline, and under the observation of disinterested persons drove the car until the fuel gave out. The tanks were certified, as was the quantity of fuel they contained. The average consumption of the 94 cars figured out at 32.8 miles per gallon of fuel. The greatest mileage obtained was made by a dealer in Milwaukee, Wis., who drove his car the almost incredible distance of 51.2 miles on one gallon of gasoline; the weather was fair. A dealer in Georgetown, Texas, drove 17.2 miles in a rainstorm.

Steam Car with Complete Condeasation.—The difficulty of obtaining really efficient condensation placed what appeared to be an effectual bar before the steam automobile some years ago; mileage was limited because of the limited amount of water that could be carried. Now, however, this difficulty would seem to have been overcome in a car that has just made its appearance in Waltham, Mass. A double-acting, single-expansion steam engine with two cylinders measuring 4 x 6 inches is used. A fire tube boiler is used, with 158 feet of heating surface, and heat is supplied by a kerosene burner; it is said the car will run 10 miles to the gallon of kerosene. The condenser is the interesting part of the car. It is an ordinary honeycomb radiator, such as is used on gasoline automobiles for the cooling system. The exhausted steam is carried directly to the top of the radiator, whence the condensed water passes back through a Venturi mixing chamber to the water tank; the temperature of the water in the radiator never exceeds about 100 deg. Fahr. The car is capable of a speed of 75 miles an hour and will accelerate to 60 miles an hour on 800 pounds steam pressure, which is normal, in 15 seconds, from a standing start.

German Tests of Military Trucks.—The German army is engaged upon a series of tests upon military power wagons, and these comprise three different trials upon the road in the shape of endurance tests. The Berlin automobile corps is divided into two columns, and the first of these proceeds toward the Riesengebirge in order to make a circuit through these mountains, which will be a rather severe trial, while the second column goes to the southwest to carry out its programme in Bavaria. On the other hand, the automobile corps of Saxony are engaged in making an endurance test toward Switzerland and the Erzgebirge. Thus all the German heavy trucks are upon the road. Another endurance test of an interesting character was organized by the German Automobile Club for various automobiles as well as motor tricycles and the like, and as it took place in the Harz Mountains the cars had a very hard time, owing to a snowfall of two or three feet on the roads near Clausthal. Here the roads were also cut up by country sledges, so that this occasioned much difficulty. Cycle cars used chains and ropes wrapped around the tires so as to avoid slipping. However, the selected route proved to be too hard, so that an easier circuit had to be chosen. Most of the vehicles showed a good performance on this occasion.

How Inventors Propose to Save Men From Sunken Submarines

Detachable Buoyant Conning Towers and Their Uses

By Major H. Bannerman Phillips

THERE have been seventeen serious submarine accidents in the last ten years, of which eleven occurred to British vessels. The total number of lives lost in submarines up to the present date amounts to 211.

With regard to the question of having special "lifting ships" in readiness to meet accidents, it has been pointed out by naval officers, first, that British submarines are stationed all round the coast—at such places as wide apart as Plymouth, Portsmouth, Harwich, Dundee, and Lamlash, as well as at places abroad, like Gibraltar, Malta, and Hong Kong, and that those attached to home ports go to considerable distances and dive in various places, so that it would be impracticable to have lifting-vessels standing by in all cases. Secondly, they say that in scarcely any known instance would a lifting ship have been of assistance in saving life, if it had been available, and that in all cases of accident where life has been preserved, it has been due to the efforts of the crew themselves without any outside assistance.

On the other hand, it has been said that officers and men of the submarine service have not hitherto attached much importance to life-saving appliances as applied to the particular vessels for which they are responsible. They have said that the air-lock and helmet might enable men to escape if circumstances were propitious, but that these same circumstances are not likely to be propitious in the case of accidents. On the contrary, they know full well that, if anything serious happens to a boat, the crew are almost certain to lose their lives, and they accept the risks as part of "the day's work."

There is no doubt that the accidents due to what may be called true submarine risks, that is, mishaps which are not caused by external interference, such as collisions, and are due to causes and circumstances inherent to the system, are steadily on the decrease, and this satisfactory result must be ascribed to the constant improvements in construction and equipment. For instance, in the "A" class of submarine in the British service (13 boats) 25 lives have been lost by collision, and 32 by foundering and explosions. In the "B" class (11 boats) 15 lives have been lost by collision—none through other causes. In the "C" class (38 boats) 13 lives have been lost by collision and one by explosion. In the "D" class no lives have been lost so far; in the "E" class there has been one accident from explosion, which was responsible for the loss of three lives.

Whatever the cause of the mishap to the "A-7," there is apparently no known reason to suppose that the conning-tower was damaged. It doubtless remained clear of the sand and mud in which a portion of the vessel was imbedded, and under such circumstances, although the airlocks and helmets may not have been of any use, owing to the depth, if the conning-tower had been detachable as a whole apparatus, water-tight and provided with air-storage, which would rise on being set free from the hull, there would have been some chance of rescuing the crew, provided they were not killed by the same cause which prevented the rising of the submarine itself. One such apparatus has been designed and patented by Mr. E. J. Castle, a retired draughtsman from His Majesty's service, and another by Mr. G. Fitzhardinge Rose of London.

Mr. Castle's idea is, to use his own words, referring to the illustration of the invention, as follows:

"To fit two towers, 5 feet in diameter, and about 5 feet 6 inches deep, constructed of steel, well strengthened inside with brackets and steel angles, and placed on the water-tight bulkheads. By this method, in the event of any one compartment getting waterlogged by escaping into an unflooded one, the crew can release themselves from the vessel by opening the escape scuttles on either side of the bulkhead in submarine and towers, and closing both when inside (making the vessel intact) and detaching them by means of clips. In the case of the "Lutine" (French submarine) where all the crew were lost, some escaped from a flooded to an unflooded compartment, and lived for an hour, but there was no detachable tower or other device by which they could get out. By my method escape is afforded from three compartments for about 8 to 10 men in each. A small hydraulic is provided for the purpose of exerting an upward pressure if required.

"On the manhole cover in each tower is a signal apparatus fitted with a cork buoy, which, on being released from inside by turning back the screw, rises to the surface, taking with it a fine flexible steel wire line; communication can be made to those inside the towers and at the surface, and will show the position of towers. The towers are 3 feet 6 inches above the deck, but they can be fitted at varying heights to reduce resistance if required.

"A flexible wire is stowed in a water-tight ring, the buoy resting upon it, the wire passing over a bracket, so as to have a vertical pull in the event of the vessel being inclined. The alarm is located below the cover; ballast is fitted for the purpose of keeping the towers stable in the light condition.

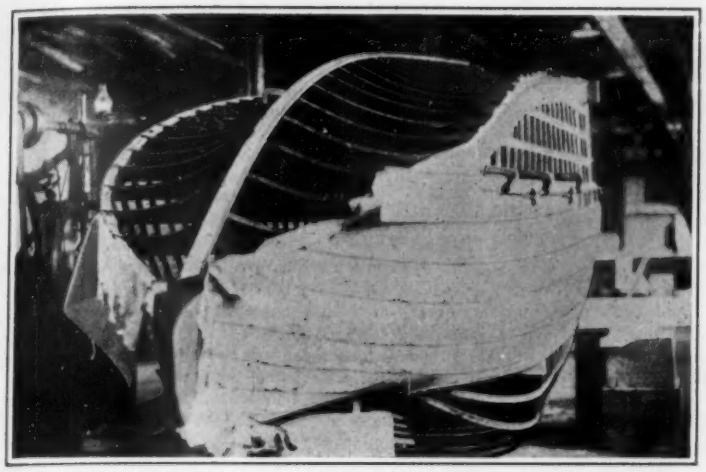
"Although the fitting of chambers is not a new idea, as a few have been patented, this plan is theoretically, and I think if tried would be found to be practically correct for life-saving purposes, and would not weaken the vessel, while at the same time giving good chances for the crew to get out at either end at great depth. There would be a danger, as with the present conning-towers, of damage in case of collision, but still the vessel would continue to be water-tight."

The small drawing in the upper lefthand corner shows the watertight escape scuttles which are fitted to each compartment, as well as to the towers. The detail drawing in the lower righthand corner shows the signal apparatus, which is located on the manhole cover in each tower. The whole is fitted with a cork buoy, which on being released, rises to the surface, taking with it a fine flexible wire, by means of which it is possible to communicate telephonically with those imprisoned in the towers. Beneath the cover is an alarm.

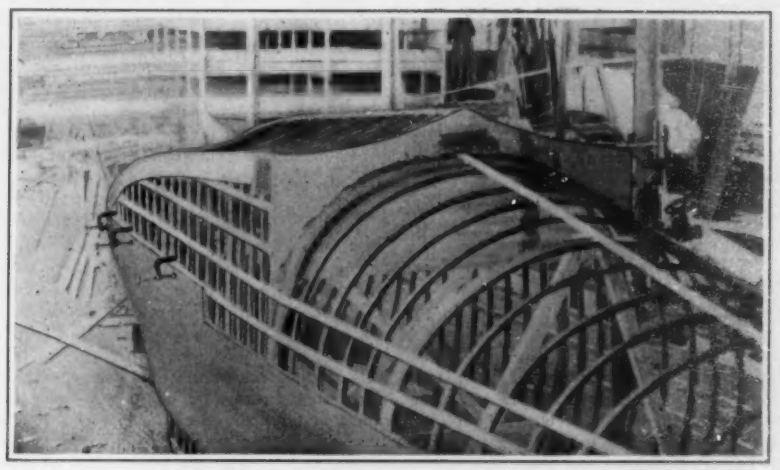
The Castle device for saving men from sunken submarines.

Mr. Rose's invention, pictured on the cover of this issue, includes a submarine lifeboat and buoy. The lifeboat consists of a cylindrical chamber some 8 feet in diameter, held under normal conditions within a water-tight compartment by means of a stout screw carried through the base. At one spot within the water-tight compartment is a secondary chamber containing a buoy attached to a length of wire. On an accident happening to the submarine, the crew enter the water-tight belt, and, sealing the door behind them, pass on to the inner cylinder. One stays behind sufficiently long to release, by means of a bevel gear, the buoy in the smaller chamber. The buoy rises to the surface at once, and indicates the whereabouts of the submerged craft. As soon as the crew are within the inner cylinder and the doors are shut, the cylinder is released from its contact with the body of the submarine by the unscrewing of the grip beneath the floor. If the compartment in which the cylinder rests has not been damaged, the cylinder at once rises to the surface by its own buoyancy. There is an electric light in the conning-tower and an apparatus for firing distance-rockets, so that, whether by day or night, attention can be called to the position of the floating cylinder, with a view to obtaining help and avoiding collision. In calm weather, a collapsible boat can be launched through the conning-tower, to enable help to be sought from the shore or from passing vessels, or to locate the search-vessels which might be sent out to look for the submarine. Provision has been made, however, for the contingency of such damage to the submarine as may prevent the lifeboat cylinder from rising to the surface and cause the detention of the crew at the bottom of the sea. Within the cylinder are two other compartments, which can be opened to the sea by a convenient gear. These contain buoys which, rising to the surface, carry with them air-tubes, electric light and telephone wires. The buoys are so shaped that they ride on the waves and keep a free air-vent, and on the exhaust-pipe of one buoy there is fitted a siren. By pumping fresh air in through the other buoy and the foul air out again through this one, the siren is worked, and the attention of passing or search-vessels called to the spot. In proximity to the

(Concluded on page 529.)



Over the skeleton is laid one skin of ¼-inch spruce. On the bottom of the forepart two skins of ¼-inch spruce are screwed to the floors.



The structure of the hull, here shown upside down, comprises the usual stringers and ribs to give it strength and form, as in standard boat architecture.

The Rodman Wanamaker Transatlantic Flier

Glenn Curtiss's Masterpiece in Flying Boats

By Our Staff Correspondent at Hammondsport

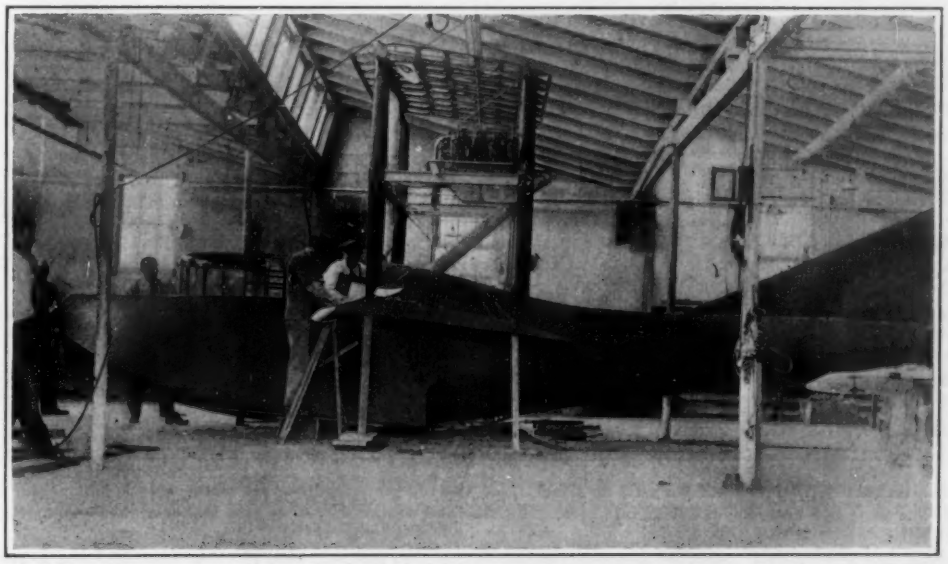
Illustrated with Photographs Copyrighted by H. Benner

THE Wanamaker transatlantic flier, publicly announced as a serious project early last February, in Mr. Rodman Wanamaker's letter to the Aero Club of America, is now approaching trial as a splendid reality. It represents, as did the great Deperdussin racing monoplane which amazed and delighted aero sportsmen in 1912 the capital achievement of a magnanimous and liberal patron of aviation, a bold, original, and severely practical aeronautical designer and manufacturer, a skillful, sagacious, and fearless pilot, all striving together for the same great end—in the present case, the joining of the hemispheres by a new route of less than one day's sail. The third man of this trio, Lieut. John Cyril Porte, R. N., of England, has been Mr. Curtiss's industrious colleague in working out the details of the huge aeroplane, and in devising the means to navigate it with precision and security.

The original plan, which for the present has been superseded by one requiring less unfamiliar construction, contemplated a tractor biplane with one direct-connected 200 horse-power engine, a whale-shaped or stream-line fuselage with detachable running gear, provided with a water screw for voyaging in the sea in case of necessity, and a closed hood and water-tight compartments for the safety of the two aviators. This craft was to rise from St. Johns, Newfoundland, leaving behind the chassis, soar aloft two miles, take the permanent easterly wind of 50 miles an hour, and, with her own speed of 60 miles, sweep straight to Ireland without a halt, at a speed of 110 miles per hour, and make the entire journey in some 18 or 20 hours.

How the Original Plan Was Changed.

The original plan would not permit of rising from midocean. It was therefore decided to employ, in the first cruise across the Atlantic, an enlarged Curtiss flying boat, capable of carrying two passengers and supplies for twenty-some hours, and, of course, capable of landing and rising at will in mid-ocean in favorable weather. In this later plan no attempt to use the upper stream of the atmosphere would be made. The start would take place when the weather forecast, especially made for the occasion by the U. S. Weather Bureau, should seem most auspicious, and the flight would be made over the most direct and practical route, now high now low, as circumstances should dictate. The transatlantic flier, now receiving its final touches in the Curtiss factory, is by far the largest aeroplane ever built in the United States, and one of the very largest in the world. Sikorsky, in Russia, and Collieux, in France, have machines—the former a land, the latter a water craft—which can carry larger loads; but they were not designed for such long distances, and could not carry sufficient fuel to attempt a flight across the ocean. Sikorsky's machine, for example, has motors aggregating 400 horse-power, and would need two tons of supplies to clear the Atlantic securely without stop.



The fore part of the hull, forming the storage-room, is shaped like a slipper; the after part is shaped like the rear end of a whale.

Lieut. Porte, who will navigate the machine on its venturesome voyage, standing beside the hull.

The Wanamaker craft is a biplane flying-boat, measuring 72 feet from wing tip to wing tip of the top plane, and 46 feet in the bottom plane; 38 feet from prow to the end of the vertical rudder; spreads about 500 square feet of wing surface, and weighs complete, with two men and supplies, about 5,000 pounds. The wings are 7 feet wide, and have a gap between them of 7½ feet. The hull is 34 feet long, 4 feet in the beam, 6½ feet deep from keel to top of hood, and generally of the Curtiss flying-boat pattern, but with a closed hood provided with numerous small celluloid windows over its top and around its front and two sides, on the level of the eyes of the aviators sitting on the bench in the fore part of the cabin.

Some of the Craft's Interesting Features.

The fore part of the hull, forming the storage-room and pilots' cabin, is shaped like a slipper; the rear part is shaped like the rear of a whale. The whale-like stern carries the horizontal and vertical control surfaces. The craft is propelled by two engines mounted midway between the planes, on either side of the hull, each directly connected to its individual propeller. The control system differs from the usual Curtiss type only in the manner of working the ailerons. On account of the great force required for this, the ailerons are worked with the feet. Thus

pushing with the right foot elevates the right aileron, thereby depressing the right wing, and *vice versa*. When the boat runs quickly along the water, it gradually rises, skates on the sole, then on the heel of the slipper, then soars aloft, the whole craft beaming scarlet, to be more clearly visible at a great distance. Such is a general description of the more striking features of the strange vessel that is to take the modern Columbus from the New World to the Old World.

The structure of the hull is fairly indicated in the accompanying illustrations. Its skeleton comprises the usual stringers and ribs, to give it strength and form, as in the standard boat architecture. Over these is laid one skin consisting of ¼-inch spruce laid lengthwise, with slight upward spiral toward the stern, and fastened on with brass screws. On the V bottom of the slipper-shaped fore part of the hull, two skins of ¼-inch spruce are screwed to the floors, or V cross-members, with blind holland laid between skins, and saturated with marine glue. The entire hull, thus framed and covered with ¼-inch spruce, has placed over it two layers of blind holland, the under one laid lengthwise, the next one wound on spirally, both brushed with marine glue, ironed hot, and finally painted. The prow is sharp vertically—a new departure—to cleave the waves and to avoid shipping water; the stern is oval, terminating in a vertical edge to which the rudder is hinged.

The interior of the hull aft the step has four watertight compartments separated by vertical cross-partitions of three-ply birch veneer 3 millimeters thick. Before the step is the large compartment, or cabin and supply room. Its rear part contains three gasoline tanks having an aggregate capacity of 1,500 gallons, all of circular section and made of tinned steel. From these tanks the fluid is pumped up to the auxiliary or feed tanks, from which it runs by gravity to the engines as needed. In the forward part of the cabin, a bench with

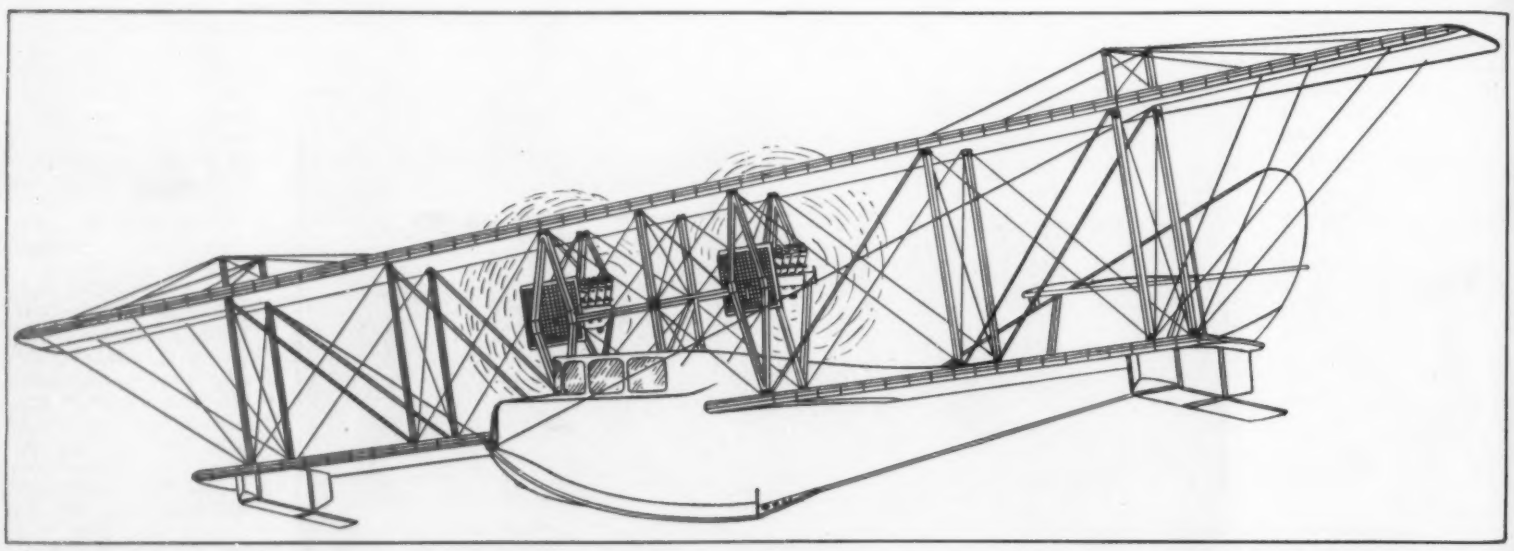
The upper planes jut about 13 feet beyond the lower ones at each side, and in this over-shoot they are cut away to the rear of the back spar, so that the ailerons may be attached there. These measure 15 feet long by nearly 20 inches deep, and turn only upward.

The engine section of the wings is peculiarly massive in structure and appearance. The lower wing spars pass through the hull, like floor joists in size, and are firmly lashed to the interior with strong ash verticals joined to them with angle iron. Each engine is supported on a massive wooden frame, sustained front and rear by a double post whose two parts are spread out, diamond-shape, and trussed like a crutch, for strength, and worked to stream-line form. The distance between the two propeller shafts is 8 feet 8 inches. The whole engine section is trussed with heavy cables, has a massive brace running obliquely down and forward into the cabin, and, as a whole, presents more the appearance of a pavilion for resisting storms than a craft to soar on thin air.

The Engines of the Flier.

The two engines are of the best Curtiss O. X. make, each of 90 horse-power, eight-cylinder water-jacketed, and running at 1,200 revolutions; they weigh, together, 690 pounds. Their radiators weigh 62 pounds each. Each presents 2 square feet of front, contains ¼-inch tubing nearly 3 inches long, and the radiator of each exposes 100 square feet of cooling surface. In the 30-hour continuous test, held the second week in June, the engines consumed together 288½ gallons of gasoline and 10⅝ gallons of oil, weighing in all about 1,800 pounds. The radiators will be placed before the engines, and the oil tanks just behind the radiators, all midway between the upper and lower planes. Bosch magnetos and carbureters complete the power plant.

The tail unit, mounted on the rear of the hull, comprises an adjustable tail plane, of some 50 square feet



The craft is a biplane flying-boat, measuring 72 feet from wing tip to wing tip of the top plane and 46 feet in the bottom plane, and 38 feet from the prow to the end of the vertical rudder. The wing spread is about 500 square feet. The machine will be driven by two 90 horse-power eight-cylinder engines.

a back stretches quite across the boat, and has a 3-inch deep corduroy cushion to make the aviators comfortable. Behind this seat is a mattress whereon one at at a time can recline or sleep, if advisable. Before the seat are the navigating instruments and the usual two-wheel Curtiss control.

The Wings of the Machine.

The over-all dimensions of the wings have been given. Their contour is that of the most efficient practical wing resulting from the systematic aerodynamic investigations conducted by the British government in its aeronautical establishment. The contour measures 7 feet in chord, 6 inches in depth of camber of its upper side one third back from the leading edge, is nearly plane or straight underneath, and dips sharply down at the forward edge, like the edge of a bird's wing, or like the wing patented by Phillips in England thirty years ago. The rear edge of the wing is somewhat flexible. Two main spars in each wing, of I-section, run throughout its entire length, and each is placed about 18 inches from the nearest wing edge. The front edge of each wing is formed of a rounded beam, approximately crescent-form. Practically all the wing woodwork is of spruce, and the internal structure, as a whole, is trussed with piano wire, according to standard good practice. The whole wing and tail surfaces are covered on both sides with a light Japanese silk, and varnished several times to make it air-tight. Near the hull the wings are so strongly ribbed and covered with veneer as to bear the weight of a man, but farther out they are built of ordinary strength. Heavy stream-line posts and heavy steel cables truss together the upper and lower planes.

surface, and semi-circular in form, to the rear edge of which is hinged the elevator, of the same area; also a fixed vertical triangular fin to whose rear edge the vertical rudder, of some 20 square feet area, is hinged.

The propellers may be the ordinary two-bladed wooden screws, of 8 feet diameter and 5 feet pitch, or some new kind not yet made public.

Lieut. Porte, after receiving the Wanamaker flier from Mr. Curtiss, at St. Johns, Newfoundland, will be in command of her during the over-sea voyage, aided by an assistant who is a skilled aviator expert in knowledge of the Curtiss motor. Mr. George Hallett will act as chief aviator, while Lieut. Porte will be the responsible navigator in authority. Mr. Hallett will be dropped at the Azores, and John Lansing Callan, one of the instructors in the Curtiss flying school, will there board the machine and complete the trip with Lieut. Porte. Mr. Hallett and Mr. Callan will relieve Lieut. Porte at the controls.

Space will not permit a description of the navigating instruments and the preparations for safety and success during the voyage. The instruments have been carefully studied, some being new to the art; arrangements have been made for assistance, if needed, *en route*; the exact route itself, and the nature of the difficulties to be met during the daring voyage, have received due attention. It is to be hoped that these details, many of them still secret, have been as well provided for as has the construction of a motor qualified to sustain a continuous voyage of a day and a night—and that the final test of Lieut. Porte's navigating provisions will be as felicitous as the 30-hour test of those stanch Curtiss engines.

Regulations for the Round the World Flight

REGULATIONS governing the round the world aerial race of the Panama-Pacific International Exposition have been submitted to the Aero Club of America.

The race, for which $150,000 will be awarded as prizes, will start from the Panama-Pacific Exposition grounds in San Francisco on May 15th, 1915. It must be completed before noon of December 4th, 1915. Licensed pilots of any country may compete and any kind of aircraft may be used. The entries will be received between November 1st of this year and May 9th of next year. An entrance fee of $500 must accompany each entry.

All competitors must pass over the course in an easterly direction, and controls will be designated by the exposition authorities, at which each competitor must alight in the order named. Each flier will submit his log book and instruments to the officials in charge of each control. Each competitor may follow any route he chooses from one control to the next, but supply stations and patrol service will be provided along only one route, the one considered most feasible.

The distance between two controls must be traversed in the same aircraft. A stop may be made anywhere, however, for repairs, even to the extent of installing new motors, and at any control the competitor may abandon the machine he has been using and go on with another one, if it be of the same class of aircraft as that in which he started the race.

Of the $150,000 prize money, $100,000 is to go to the flier finishing first, $30,000 to the second, and $20,000 to the third, provided the flight is made within 121 days. If the first flier fails to make his way around the world within 121 days, but does it on or before December 4th, the first prize will be reduced $1,000 a day for each day more than the 121 required to finish. Reductions are to be made from the second prize at the rate of $300 a day, and for the third prize at $200 a day.

If none succeeds in the flight, but one or more do it all except across the Atlantic and Pacific oceans, or any other body of water, there will be a reduction of $20 from the first prize for each nautical mile not traversed; $6 from the second prize; and $4 from the third. These deductions will be in addition to those for time over 121 days.

Arrangements are made for third, fourth, fifth, sixth, and seventh prizes in case the deductions from the first, second and third prizes make them possible. No prize shall be paid to any one who does not finish the race before December 4th. Fliers may carry aids or passengers and may change them *en route*, but the pilot of record must be in control at all starts and alightings.

Another Zeppelin Accident

ANOTHER of the Zeppelin airships of the German army, the "Z 1," was badly wrecked near Diedenhofen, on June 13, according to press dispatches. While trying to effect an emergency landing the air cruiser broke at right angles behind the rear car. A lieutenant was injured.

The accident occurred during a flight from Cologne to Metz. The "Z 1," with a military crew on board, ran into a rainstorm and the commander decided to descend. When the air vessel was within a few yards of the ground a sudden gust of wind dashed it violently to earth and it broke virtually in two. The airship can probably be repaired.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Color Music

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been drawn to the SCIENTIFIC AMERICAN, dated February 21st, pages 163-170, in which appears an illustrated article entitled, "An Organ on which Color Compositions are Played: A New Art of Color Music and its Mechanism," by John W. N. Sullivan, and I have read this with very considerable interest.

In this connection I might mention that Prof. Rimington and myself have been workers in this sphere, unknown to each other, and I registered my patent in the Commonwealth of Australia on January 22d, 1912. I have since obtained a patent in Great Britain for "Color Music," dated December 23d, 1912, No. 29615/1912. ALEC B. HECTOR.

Sydney, Australia.

Sun-power Plants Not Visionary

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 23rd of this year appears an article headed "Energy from the Sun," in which you have expressed yourself too pessimistically.

The only invention claimed in the Egyptian sun-power plant is the *generating of steam by the heat of the sun*, and only the amount of steam generated should be taken into consideration.

Unfortunately, there were serious mistakes made in the shop work of the construction of the engine and pump, which did cut down the amount of pump horse-power delivered to 19.1. These mistakes would have been avoided had we tested the engine and pump at the works before sending them to Egypt, and will not occur again.

The sun heat absorbers generated steam enough to give *an average* of 50 brake horse-power for ten hours a day, as will be seen if Mr. Ackermann's tests are read by taking into consideration only those tests which were made at 15 pounds absolute (the pressure at which the sun heat absorbers are to run).

We are, therefore, right in calling this steam-generating plant one of 50 horse-power instead of 19.1.

Now a careful estimate by an experienced builder of power plants shows that the steam-generating portion of this plant can be duplicated and erected in the tropics when done on a manufacturing scale by special machinery, for the sum of $7,800, or $156 per brake horse-power.

It is entirely true that this is considerably more than the cost of the best modern steam plants of equal power, but it must be borne in mind that when this plant is once erected, it not only furnishes the required power *perpetually*, but may be said to *"raise its own coal,"* and this puts the sun-power plant in an entirely different class, and justifies most careful thought.

The plant is so constructed that it has a very long life and requires little repairs, and is, in fact, very simple.

It is true that sun-power plants do occupy a great deal of ground, but ground in those portions of the tropics where we at present intend to confine ourselves has practically *no value*, and therefore it is merely a matter of cost of construction, maintenance, and cost of running.

Maintenance and cost of running is a little less than that of an equal power coal plant, and therefore the comparison narrows itself down to a matter of interest on the increased investment, and careful figures show that, taking this into consideration, we can compete with coal at $2.50 per ton in those portions of the tropics where the sun shines practically throughout the year.

For the next ten years or so we expect to confine ourselves to irrigation in those regions of the tropics where coal is $15 per ton and above, and where we can count on at least 90 per cent of sunshine during the days of the year, and there we *know* our present sun-power plants will effect great savings. This field alone is large enough to give us all the work we shall be able to handle for some ten years to come.

We have devoted seven years of time and have spent nearly a quarter of a million dollars in investigating every possible phase of sun power, and firmly believe we have solved the problem of utilizing, for the benefit of the human race, this greatest of all natural forces, and ask all engineers to look at this great problem from all sides, and very carefully, before putting it into the visionary class.

The problem of flying in the air has been nearly solved, but only fifteen years ago it was called a dream of the far-distant future.

Up to the present time in all the history of the human race, only three natural forces—wind, water, and fire—have been utilized, and it is about time that all thinking men should seriously occupy their minds with utilizing the greatest, the cause of them all—the sun.

Certain it is that it must be done within the next one hundred years or so, or else we shall have to revert to barbarism, because eventually all coal and oil will be used up.

Sun power is most logical. We know the sun is the central power-house of our universe, and we should, therefore, attack most seriously the problem of connecting ourselves with the sun *direct*.

Please do not take our attempt as the final. Natural forces are not entirely conquered in a few years. The first steam engine was not a quarter as efficient as our present ones. We know quite well that we have only made the beginning, and that the sun-power plant of ten years hence will be at least twice as efficient as the one we have just tested, and that improvements will be made every year, but someone must make a beginning in a practical and *public* way, and we have done this to the best of our ability. FRANK SHUMAN.

London, E. C., England.

The Ease of Variable-star Observing

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of April 4th, 1914, contained an excellent article, "The Attractions of Variable-Star Observing," by Dr. Edward Gray. It savors somewhat of presumption to attempt to supplement Dr. Gray's word, but it struck me possibly the Doctor had not sufficiently emphasized the ease with which this work may be taken up by the beginner. It occurred to me, therefore, that the very fact that Dr. Gray is one of the pioneer amateur observers of variable stars, while I am but one of the very "new beginners," might place me almost in a better position to demonstrate to other beginners how easily they can make a start at this fascinating form of useful observing. A bald recital of my own recent experiences may perhaps prove my point.

The possession of a good small telescope (a 3-inch objective) had for about a year and a half been a source of great pleasure. But "sight-seeing," even in the heavens, grows monotonous, and the trip to the roof of a New York apartment house, my only "observatory," became more and more laborious. Finally, the telescope remained for weeks at a time untouched—a stagnant investment. It was but a few months ago, having but a vague idea of what a variable star was, that I wrote to the secretary of the American Association of Variable-Star Observers, Mr. William Tyler Olcott, Norwich, Conn., asking for information as to how to begin, and for help in beginning, variable observing. Promptly, I received a most explicit reply, together with a number of variable charts, and that very night, with no difficulty, picked up several fields and recorded several observations. This certainly shows that a start is not hard to make, even for the veriest tyro. A letter to the Harvard College Observatory brought an equally prompt response in the form of some of the observatory bulletins describing how best to make observations, accompanied by several more charts. Since then the secretary of the association has, from time to time, in fact, every few days, added charts to my list, until this comprises well over one hundred different ones. As a result, my telescope, far from standing idle, finds every clear night a definite, interesting, and constantly new work to do.

My equipment is of the simplest; a 3-inch telescope, without even a "finder"; a pair of field-glasses, a star-atlas, price $1, and the charts supplied with no cost to me. Many observers have telescopes mounted equatorially, and having "circles," which enable them to "set" on a variable field immediately. For them, I have almost a feeling of pity—they lose the delight in "sweeping" a region in search of a variable-field and at last locating it, which method, although it often requires more time, bears with it a joy much akin to the "Easter-egg hunting" of our childhood. The feeling that one is "growing warmer," the sudden recognition of some small configuration of stars marked upon the chart, and the final most satisfactory *"There's* the variable," can never be experienced by the more scientifically equipped.

Using, by necessity, this less scientific, but I insist this more sporting, method, the first move is to mark on the star-atlas the position of the variable, or, rather, the variable-field, this being always given on the chart itself. The relation of this position to the naked-eye stars shown on the atlas enables the observer immediately to sight his instrument at *about* the correct position, and then a few moments' careful "sweeping" identifies the variable. Surely nothing can be much simpler. It is true that sometimes a field will prove most elusive, but care and patience always are successful, and the pleasure in finally triumphing is perhaps even increased by the difficulty. It is also true that, after but very little practice and a consequent knowledge of the positions of the fields, a variable is found at the first sight, and the sweeping search is unnecessary.

Once in the field of view, it requires but the most brief experience to compare with good results the brilliancy of the variable with the various standard comparison-stars, whose magnitudes are marked on the chart. Some care must be used in making estimates of deeply-colored stars, which often appear too faint upon first sight, and whose true brilliancy is not recognizable until their light is allowed to "sink into" the eye; but, at the most, three or four minutes is ample time to obtain an estimate of magnitude often of remarkable accuracy.

The use of the field-glass becomes practical in many cases where variables wax high enough in magnitude to make the greater light-gathering power of a telescope unnecessary. I have often found my field-glass available as a substitute for a "finder," which my telescope lacks. Where, particularly in our hazy New York skies, it is impossible to see with the naked eye the fainter stars marked on the star-atlas, especially when these stars are included in the variable-field, the field-glass can be of great assistance.

Dr. Gray pointed out most clearly the fascination and the real value of this variable observing, but it does not seem out of order to reiterate that it is practically the only steady, useful work which amateurs can do with small instruments. It is gratifying to know that the work is much appreciated by the Harvard College Observatory, the headquarters in this country for this branch of astronomical research. Recently, the director has placed in the hands of the secretary of the association a large number of variable charts for distribution among the members of the association, and in his latest report the work of the association is spoken of in a most complimentary manner.

It is to be hoped that the membership of the association will continue to grow in numbers as rapidly as it has during this past year. More observers are needed—there cannot be too many—and anyone possessing an instrument with an object-lens of two inches or over will certainly find the work well worth undertaking. They may be sure, also, of a warm welcome to the ranks of the variable observers, and of obtaining all the assistance which lies in the power of the members to give. EDWARD W. PUTNAM.

New York City.

A Chance for Some American to Build an Iron Foundry in Poland

ONE of our European subscribers sends to us the following inquiry:

"We intend to erect a steel and iron plant in this country, and we request you to indicate what firms would be willing to consider our needs, the following general specifications to be observed:

"1. The iron plant is to have a yearly production of about 11,500 tons. Of this output 6,560 tons are intended for the production of water collar and bowl pipes; 1,640 tons for fittings to these pipes; and 3,300 tons for casting various machine parts, such as transmission wheels, gears, parts of water turbines, aqueduct piping, special machinery for sugar and other plants.

"2. The steel foundry is to have an annual production of about 6,000 tons. Of this output 3,300 tons will be used for producing blocks for hydraulic presses and hammers, rollers, etc., and 3,300 tons for various steel castings, such as railway car wheels, parts of railway cars and locomotives, gear wheels, bridge members, parts for high-pressure steam engines, rollers, and sundry small castings.

"3. In order to carry on the operations described, we intend to erect one Siemens-Martin furnace having a capacity of about ten tons of metal and shops for general work in which the following departments are to be found: *a*. Manufacture of water turbine parts; *b*, manufacture of water pumps; *c*, railway car wheel shop; *d*, gear wheel shop for turning out cylindrical and conical gears as well as Wuest's and Cytroen's gears."

The SCIENTIFIC AMERICAN will be pleased to place American manufacturers and engineers in communication with our correspondent.

An Honorary Degree Conferred on the Commissioner of Patents

HON. THOMAS EWING, Commissioner of Patents, received the honorary degree of Doctor of Laws from Georgetown University. Dean Breeden in conferring the degree characterized the Honorable Commissioner of Patents as "a man of action who attained such eminence as drew to him widespread attention, and deserving of the high post of public office."

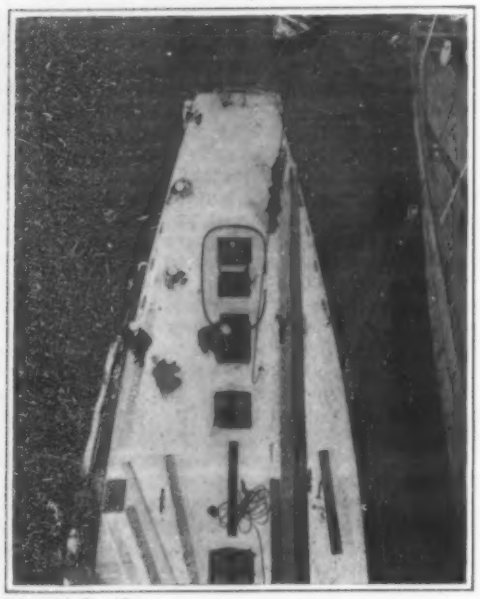
A French Entry for the Transatlantic Flight

THE French aviator, Auguste Maicon, has been entered for the *Daily Mail's* transatlantic flight for a prize of $50,000 by Paris Singer, a wealthy American resident of Paris, at his own request.

Mr. Singer, who employs Maicon in his "aeroplane stable" at Cap Ferrat, will finance the venture.

The Challenger "Shamrock IV" Under Sail

New Yacht Easily Outsails Fastest British Cutter in Moderate Winds

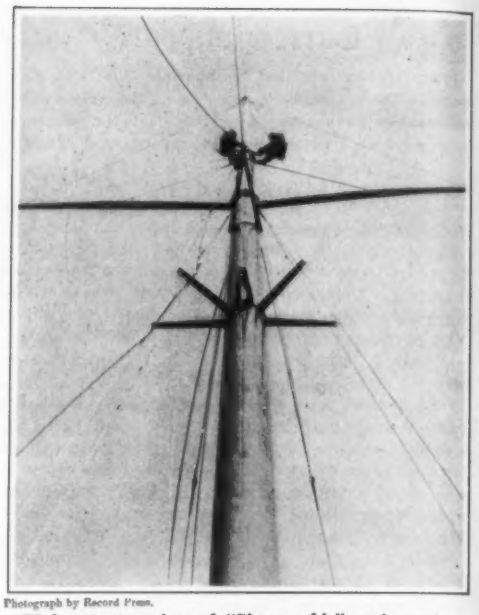


Photograph by Record Press.

Deck view, taken from masthead.

Photograph by Paul Thompson.

The 23-meter "Shamrock" (right) trying out "Shamrock IV."



Photograph by Record Press.

Elaborate trussing of "Shamrock's" mainmast.

NOT until "Shamrock IV" meets either the "Resolute" or "Vanitie" next September on the Sandy Hook course, will anybody, not even the men who designed the boats, have the least idea which is the faster of the two. There is no question whatever but that both Herreshoff and Gardner have turned out, in the 75-foot class, two boats which could easily save their time allowance over "Reliance," and, under certain conditions of wind and weather, such as light airs and a tumbling sea, might beat the 90-foot yacht with time allowance excluded. If proof of this were wanted, it is sufficient to point to the first of the three trial races held recently over the Sandy Hook course, in which the winner, the "Resolute," made the thirty miles to windward and leeward in the record time of 3 hours, 15 minutes, and 41 seconds. To appreciate the significance of this, we must remember that the next fastest time, 3 hours, 24 minutes, 39 seconds, made by the 86-foot "Vigilant" against "Valkyrie II," was done under the favorable conditions of a strong wind of about twenty knots; whereas "Resolute" made her record in a wind which varied from say ten to fifteen knots in strength. At the present writing, "Resolute" seems to have taken the measure of "Vanitie" going to windward, for she beat her in this particular race 3 minutes and 49 seconds, in the fifteen miles to the outer mark, and in the third race she beat "Vanitie," in ten miles of windward work, by 4 minutes and 1 second. On the other hand, "Vanitie" is considerably faster than "Resolute" in reaching, for in the second race, on a reach of ten miles, she outsailed the "Resolute" by 4 minutes and 29 seconds.

But what about "Shamrock IV"? Has Nicholson succeeded in getting the same speed out of a 75-footer as we have on this side of the water? The only measure of her speed is the old "Shamrock," also a 75-foot yacht, with which Sir Thomas Lipton made a pretty clean sweep for some years past in the 75-foot class in European waters.

It should be explained that this "Shamrock" is not one of the old challengers for the cup; for each of these went to the scrap-pile long ago. The "Shamrock" was built in the new 23-meter (75-foot) class several years ago, under the International Rule, the object of which was to provide a fast racing yacht, which would be of strong construction, habitable, and suitable for cruising purposes if it were desired so to use her. This rule was drawn with the object also of cutting out the long, full overhangs and the shoal skimming-dish hull and keels of exaggerated draft, which characterized "Reliance" and to a lesser degree, "Shamrock III." The rule tends to produce a boat similar to "Resolute" and "Vanitie," and it is probable that the underwater form of the old "Shamrock" lies somewhere between that of these two boats. At the same time it must be remembered that, since "Shamrock," under the International Rule, had to be built to Lloyd's requirements as to scantling, etc., she is probably much heavier in build than either of our cup defenders, and therefore, presumably, she is not so fast. On the other hand, the "Shamrock" holds the record for speed for a 75-foot cutter, and indeed, as far as we know, for a cutter of any length over a 48-mile course. This achievement she put to her credit in a hard-sailed race over the inside course off the Isle of Wight, in which she covered just under 48 miles in exactly 4 hours, which means that she must have maintained an average speed of slightly under twelve knots.

This race, of course, was sailed in a very strong wind, and, thus far, in the trials between "Shamrock" and "Shamrock IV" there have been no tests of exactly this character. On the other hand, if the cabled accounts are correct, Lipton's new yacht defeated the old "Shamrock" over a triangular course of fifteen miles by 9 minutes and 4 seconds. The most significant fact about this race is that she beat the old boat 6 minutes in five miles of windward work, or over a minute a mile. Over a windward and leeward course of fifteen miles, out and back, this would mean a gain of over 18 minutes at the outer mark.

These results are so extraordinary, achieved as they were against a well-proved boat of the same class and same length, that we feel inclined to doubt the accuracy of the timing or the distances. Nevertheless, it is well established that "Shamrock IV" is a remarkably successful yacht in working her way out to windward. Also, she is said to have beaten the old "Shamrock" almost as much as a minute a mile when running down the wind in a light breeze. On a reach, however, she does not show much superiority; and it is on this account, doubtless, that "Shamrock IV" is to be given a double head rig (jib and staysail) in place of the single jib which she has hitherto carried.

To our mind the most significant fact regarding Lipton's new boat is that in light airs she has not shown much superiority to the old "Shamrock," this being due to the fact that, because of her full body and unusually long keel, her wetted surface must be very large for a 75-footer, and as the wind lightens in strength, the area of wetted surface becomes a most important factor. In spite of her large sail area, it is probable that the ratio of sail area to wetted

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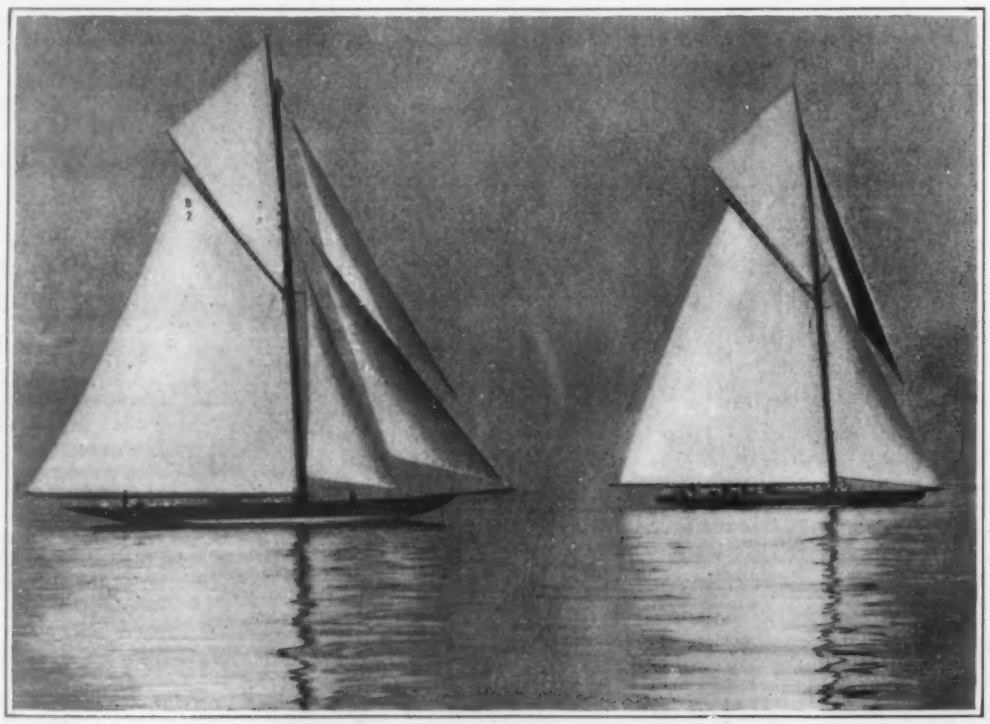


Photograph Copyrighted by International News Service.

Lipton's 23-meter (75-foot) "Shamrock," at left, and "Shamrock IV."

Note the lofty rig of the challenger, her straight sheer, and low freeboard.

Repair of Los Angeles Aqueduct Siphon

Collapsed by Atmospheric Pressure; Restored by Hydraulic Pressure

By Burt A. Heinly

A PECULIAR accident which is at once a striking illustration of the terrific force of atmospheric pressure and at the same time the counteracting effect of hydraulic pressure was that which brought the rupture and repair of the Antelope Valley steel inverted siphon of the Los Angeles aqueduct, in the period extending from February 20th to March 18th, 1914.

The Los Angeles aqueduct, the 233-mile watercourse by which the city of Los Angeles is to procure its domestic water supply from the Sierra Nevadas, crosses the Antelope Valley at its upper end, about one hundred miles northwest of Los Angeles, in the shape of a concrete and steel pipe with a total length of 21,685 feet. The concrete approaches end where the head exceeds 70 feet, and their total length is 6,149 feet, leaving 15,596 feet of steel pipe, 10 feet in diameter, with a head ranging from 70 feet to a maximum of 200 feet. This line was completed in the Fall of 1912 at a cost of $249,200, and is claimed by engineers of the Los Angeles aqueduct to be the longest line of pipe of such large diameter in existence. The thickness of the steel ranges from ¼ inch to ⅜ inch.

On the night of February 20th, following three days of heavy rainfall, the two concrete piers supporting the siphon at a point near the center of the valley, where the line crosses a ravine, were undermined and fell on their sides. The siphon which was in operation at the time was ruptured, permitting the water to flow out under a very high velocity. There then followed a collapse of 10,000 feet of the siphon. The line lies half buried in the ground, so that the under half was uninjured, but the upper half was driven in with such great force that the upper semi-circumference was bent downward, in many places, to within a few inches of the lower semi-circumference.

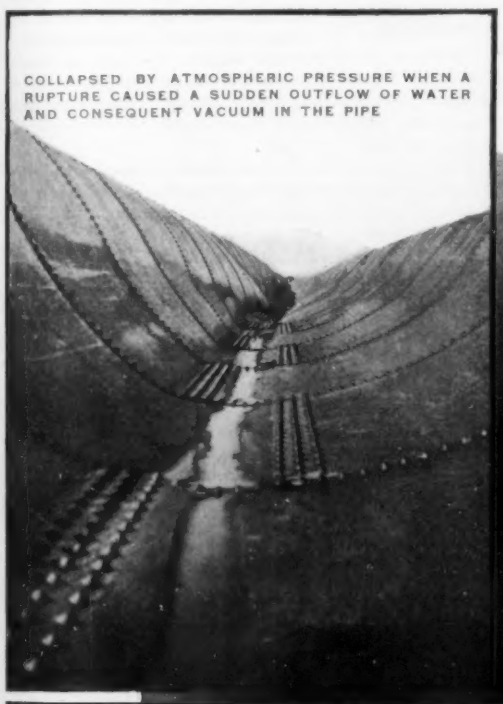
At a point 400 feet from the northern or inlet end of the steel pipe, several of the plates were torn and the rivets sheared, the rupture at this end not being fully explained. The pipe was open at both ends, allowing the free entry of air. There were no summits in the pipe and no air valves were installed. The concrete approaches, and the ⅜-inch plate, were uninjured.

The pipe, on the morning after the mishap, had a "U" shape as shown in the illustration. Its rehabilitation by water pressure, while simple in the extreme, is noteworthy on account of the magnitude of the work, and has attracted the attention of the engineering world.

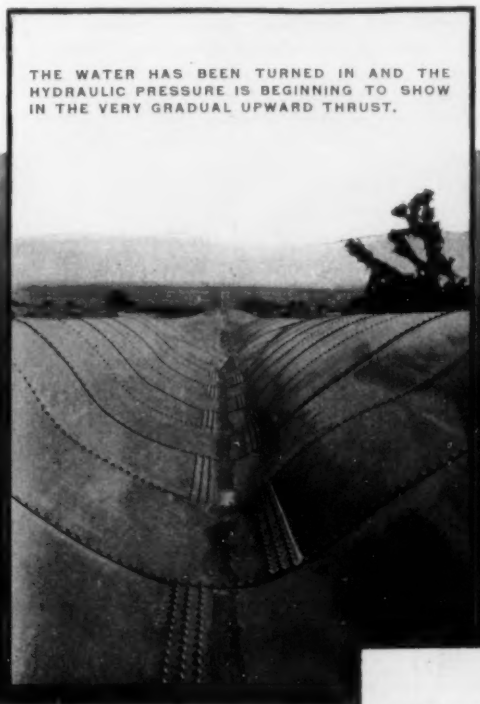
Under the direction of the chief engineer, Mr. William Mulholland, new plates to replace those torn, were rolled, sheared, and punched, transported by wagon 35 miles across the desert to their destination and riveted into place. New piers had been constructed in the *interim* to replace those which had been washed away.

The aqueduct was then placed in operation. A flow of 750 miner's inches, 405,000 gallons per hour, was then turned in. Under a head which at first did not exceed two feet, the heavy steel plates, upon which steel hammers had had little effect in the attempt at straightening, began very slowly to "iron out." As the pressure was slowly permitted to increase, with a gradually added flow up to 2,000 miner's inches, 1,080,000 gallons per hour, the pipe assumed what will be to the layman the unusual shapes shown in the accompanying diagram, until it returned to its truly cylindrical form. At one time, it assumed the shape of an ellipse with a major diameter of 14 feet 6 inches.

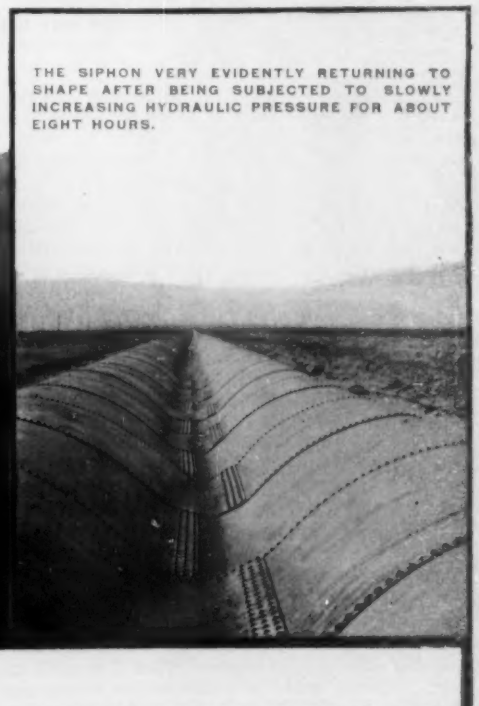
To the engineer it will be interesting to know that in this transition, none of the longitudinal seams were sheared and that only a small amount of caulking of the last named seams was necessary. In some instances, for distances of 400 or 500 feet at a stretch, the return to rotundity was made with no damage whatsoever to the pipe. At other points, only the caulking tool was required. For repairing the damage due to collapse, the expense did not exceed $250, and for the whole work of repair, which included cost of and fitting in the new plates, building concrete piers, and preparing against the repetition of the accident, the amount expended was within $2,200.



COLLAPSED BY ATMOSPHERIC PRESSURE WHEN A RUPTURE CAUSED A SUDDEN OUTFLOW OF WATER AND CONSEQUENT VACUUM IN THE PIPE

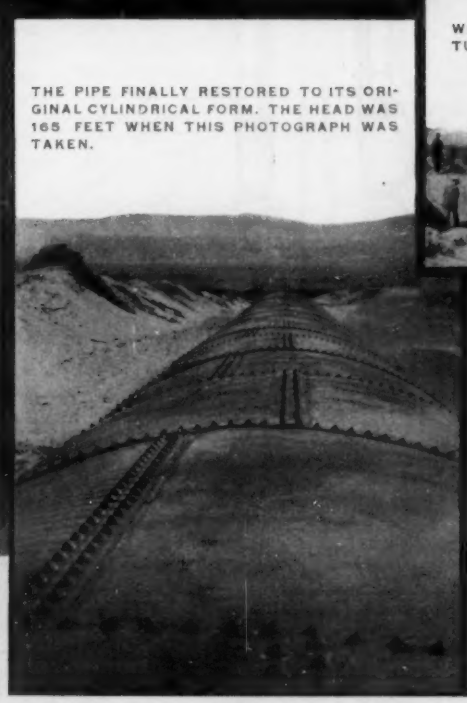


THE WATER HAS BEEN TURNED IN AND THE HYDRAULIC PRESSURE IS BEGINNING TO SHOW IN THE VERY GRADUAL UPWARD THRUST.

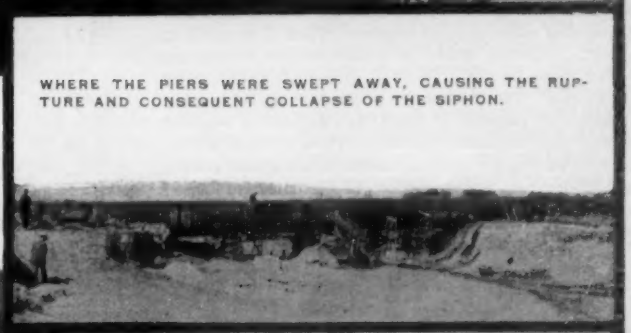


THE SIPHON VERY EVIDENTLY RETURNING TO SHAPE AFTER BEING SUBJECTED TO SLOWLY INCREASING HYDRAULIC PRESSURE FOR ABOUT EIGHT HOURS.

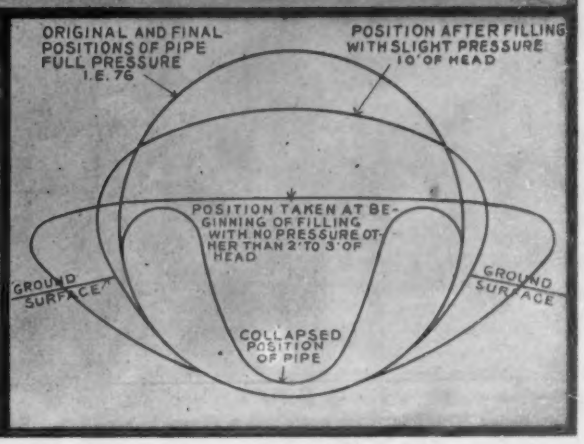
HERE THE PIPE HAS ASSUMED THE SHAPE OF AN ELLIPSE WITH A MAJOR AXIS OF FOURTEEN FEET SIX INCHES.



THE PIPE FINALLY RESTORED TO ITS ORIGINAL CYLINDRICAL FORM. THE HEAD WAS 165 FEET WHEN THIS PHOTOGRAPH WAS TAKEN.



WHERE THE PIERS WERE SWEPT AWAY, CAUSING THE RUPTURE AND CONSEQUENT COLLAPSE OF THE SIPHON.


ORIGINAL AND FINAL POSITIONS OF PIPE FULL PRESSURE I.E. 76
POSITION AFTER FILLING WITH SLIGHT PRESSURE 10' OF HEAD
POSITION TAKEN AT BEGINNING OF FILLING WITH NO PRESSURE OTHER THAN 2' TO 3' OF HEAD
GROUND SURFACE
GROUND SURFACE
COLLAPSED POSITION OF PIPE

Collapse of the Antelope siphon of the Los Angeles aqueduct and its restoration by hydraulic pressure.

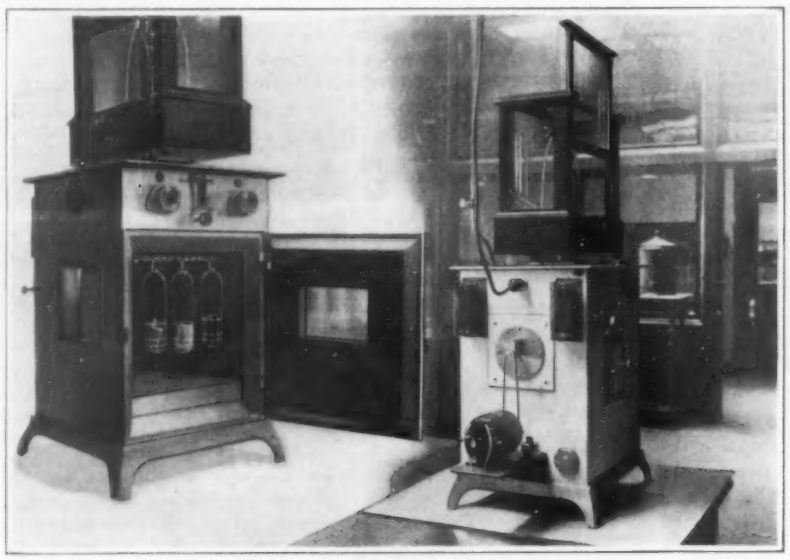
A New Rotating Sleeve Motor

A NEW motor of the non-poppet valve type has just appeared in which a single sleeve acts as a valve, whereas practically all other motors of the sleeve valve type have two sleeves. This motor also differs from others in the fact that the sleeve revolves continuously at one quarter crankshaft speed. A few years ago a rotating sleeve motor was introduced from France, but the present motor differs from that in the fact that it has a stationary sleeve, or cylinder, around which the rotating sleeve operates. An important feature of the new motor is that both the stationary sleeve or cylinder and the rotating sleeve may be removed readily from the water-jacket without the necessity of disassembling the engine and separating the cylinder from the gear-case in order to reach the sleeve. Not even the timing of the gear is disturbed in removing the cylinder or the sleeve valve.

The improved motor is made up of four principal parts. Outside there is the common cylinder casting, containing the water-jacket portion. Within this is placed a fixed sleeve with enough clearance around it to receive the rotating sleeve. Last of all, comes the piston, which reciprocates within the fixed sleeve. In the photograph showing the various parts, the rotating sleeve is indicated at *A*, the fixed sleeve, or cylinder, at *B*, while the third view shows the sleeve, the cylinder, and the gearing assembled. The sleeve *A* is connected with a spiral gear *G* by means of square-jaw clutches. The gear *G* is engaged by a spiral pinion *P*, mounted on a shaft that lies parallel with the crankshaft. The valve shaft is driven by geared connection with the crankshaft, as shown in the photograph of the motor with the cover of the gear-case removed. The sectional drawing shows how the gear wheel *G* is clamped between the bottom of the water-jacket and the top of the crank-case and is not disturbed when either the valve sleeve or the fixed sleeve is removed. The fixed sleeve, which is indicated by a solid black line in the drawing, is formed with an enlarged water-jacketed head that is held in place by means of four bolts. The spark plug is inserted through the center of this water-jacketed head.

The revolving sleeve is formed with two rectangular ports *Q*. The stationary sleeve, or cylinder, also has two ports, marked *S* and *E*, the former being the intake port, and the latter the exhaust port. These are opened successively at the proper time by the port *Q* in the revolving sleeve *A*. Because the sleeve revolves at one quarter crankshaft speed, it must have two ports which alternate in their functions. This gives each port ample time to cool, and permits of better lubrication. Oil under pressure is supplied to the sleeve through a spiral groove therein.

The timing of the motor is as follows: The intake begins to open at 14 degrees past top dead center, and attains full opening in 82 degrees. Then it remains at maximum opening while the crank travels 28 degrees, closing thereafter in 82 degrees, giving a total range of 192 degrees. The exhaust valve has a range of opening covering 228 degrees, of which 110 degrees is required in obtaining maximum opening. Then there is a continuance of 8 degrees at maximum opening and closing in 110 degrees, thus bringing the exhaust to closed position at 5 degrees past the top dead center. The exhaust starts to open at 43 degrees ahead of the bottom dead center, and the intake starts to open 14 degrees after top dead center, and is closed at 26 degrees past bottom center. These timings have been adopted after careful test to work out a motor which will idle at slow speed and develop maximum horse-power at relatively high crankshaft speed. With this timing on a six-cylinder block motor, with cylinders of 3⅛ by 5½ inches, operating at 2,400 revolutions per minute, 55 horse-power has been obtained on a block test. The weight of the motor is but 550 pounds. The motor is lubricated by a force-feed system, with pressure supplied by a gear pump located in the crank-case.



The oven has a one-fifteenth horse-power motor connected by a belt with the fan which maintains a circulating atmosphere within the oven.

Science and the Tariff

By Dr. E. E. Pickrell

DUE to extensive publicity of recent years, everyone realizes that the United States Government employs a scientific means to provide pure food and drugs to the consuming public. But few people are aware that science is a valuable assistant to "Uncle Sam" in the enforcement of the tariff laws in ascertaining the duties on imported merchandise, and that the application of every new tariff is more dependent on science. How many persons realize, when they purchase an article made wholly, or in part, of imported cotton yarn, or cloth, that the United States Government, in collecting the duties on that article, took into consideration the fact that cotton yarn and cloth are hygroscopic, and the amount of moisture they contain is dependent upon the temperature and relative humidity of the atmosphere? But few have a knowledge that in the administration of the cotton schedule of the tariff act of October 3d, 1913, the U. S. Treasury Department has taken into consideration the moisture content of cotton yarn and fabric. Schedule I (otherwise known as the cotton schedule) of this act provides for cotton yarn and fabric at an *ad valorem* rate of duty and establishes the lines of demarkations of the various classifications, according to the yarn number.

In the ascertainment of the yarn number the weight of the yarn, or cloth, is one of the principal factors. The moisture content, therefore, bears an important relation to the weight, and consequently to the yarn number. The quantity of moisture cotton cloth or yarn contains depends upon the temperature and relative humidity of the atmosphere. As an illustration, let us take a sample of 840 yards of cotton yarn, which under atmospheric conditions of 70 deg. Fahr. temperature and 65 per cent relative humidity, weighs 116.67 grains. The yarn number of this sample is 60, for a No. 1 cotton yarn is a yarn 840 yards of which, under these atmospheric conditions, weighs 1 pound, or 7,000 grains, and a No. 60 cotton yarn weighs 1/60 of 7,000 grains, or 116.67 grains. In this sample the proportion of moisture to dry cotton is as 8½ parts to 100 parts, or 9.14 grains to 107.53 grains.

Expose this sample for a sufficient period of time to an atmosphere of 73 deg. Fahr. and 46 per cent relative humidity, and it would weigh 114.19 grains. Its yarn number would be 7,000 divided by 114.19, or 61.3. The moisture content would be 114.19—107.53, or 6.66 grains, representing 6.19 per cent of the dry cotton. Place the same sample in an atmosphere where the thermometer reads 68 deg. Fahr. and the hygrometer records 97 per cent, and its weight would be increased by 121.95 grains, which is equivalent to a yarn number of 57.4. The moisture content would be 121.95—107.53, or 14.42 grains, which represented in percentage of the dry cotton contained in the sample, is 13.41. It is, therefore, quite apparent that a few degrees in temperature and a variation in the relative humidity has an appreciable effect upon the weight of cotton yarn, and consequently the yarn number.

If, on the day of importation of a consignment of cotton yarn into the port of New York, the thermometer registered 73 degrees and the hygrometer returned a reading of 46 per cent, its yarn number, as ascertained, would be 61.3, and the merchandise, accordingly, classified under paragraph 250 of the tariff act as cotton yarn exceeding 59s to 79s at 22½ per cent *ad valorem*. But, provided the temperature and humidity had been 68 degrees and 97 per cent, respectively, the yarn number would necessarily have been 57.4, and in the classification of the importation, a rate of duty of 20 per cent *ad valorem* would have been assessed as for cotton yarn exceeding 49s to 59s. To avoid these differences of

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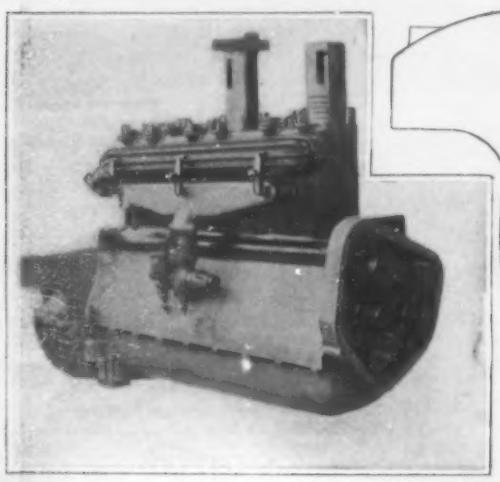
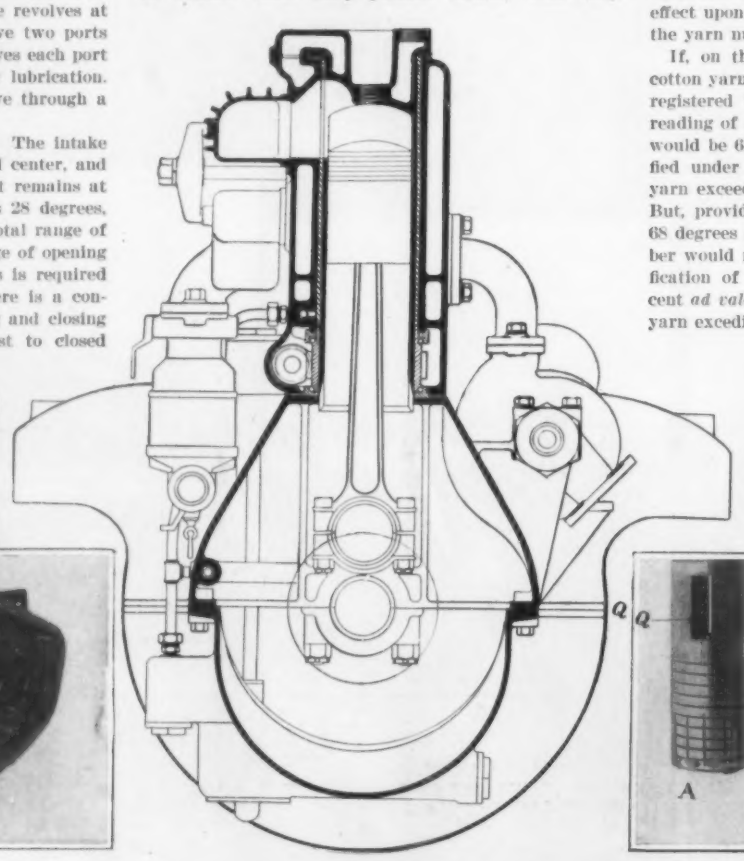
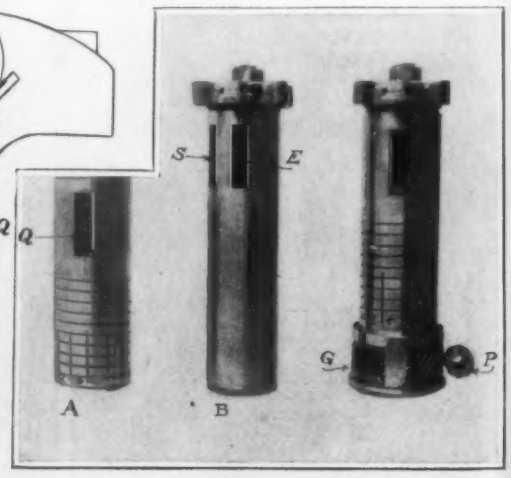


The motor with gear-case open and a sleeve and cylinder set on top.



Section showing the mounting of the sleeve valve and the cylinder.



The sleeve and cylinder shown separate and assembled with spiral driving gear.

X-Ray Photographs of Flowers

By John W. N. Sullivan

THE discovery of the remarkable penetrative powers of X-rays has received applications in surgery and medicine for some time. But, in one sense, the X-rays which are produced in the ordinary way have the defects of their merits; they are valuable for their penetrative powers, but for some work these are too marked. It is found that if the X-rays from an ordinary Crookes tube are used for viewing the chest of a man, for instance, then the addition or subtraction of a few articles of clothing makes little or no difference to the resultant photographic image. Such high penetrating rays were found quite useless for obtaining radiographs of such delicate structures as a feather, leaf of a plant, or the petal of a flower.

But it has been recently found that by using a specially designed tube under suitable conditions, giving out the softest possible X-rays, not only could radiographs of such structures be secured, but that they showed sufficient detail to admit of magnifications varying from 10 to 40 diameters. A tube capable of producing these rays was designed by Lindemann, who suggested the introduction into the tube of a window made of lithium glass. Such a window offers but a slight resistance to the passage of the softest X-rays it is possible to produce.

Tubes of this type have been used by radiographers all over the world for several years, but it was not until the last two years that their use in obtaining radiographs of thin transparent objects was fully recognized. Beautiful radiographs of flowers, insects, and opaque objects were first exhibited in England at the exhibition of the Royal Photographic Society held in London in October of last year by Pierre Goby, for which he was awarded a medal.

The apparatus for producing such radiographs has since been considerably simplified and the experiments of Hall-Edwards have been made with tubes which had been in use for several months, and with but the addition of a few simple pieces of apparatus, which can easily be constructed by anyone possessing an elementary amount of technical skill.

The tube with which he has achieved the best results is a Bauer heavy anode tube, provided with a Bauer regulator. This tube has been in daily use for months, and the glass is heavily coated with platinum. For ordinary use it requires to be constantly lowered, as it becomes high after a medium exposure.

When working, the vacuum is lowered to such an extent that the cathode stream becomes quite visible, and should it disappear during the somewhat long exposure necessary, more air is pumped in from time to time. For flower studies Ilford X-ray plates are used, enclosed in a couple of Tyler's light-tight envelopes.

The plate is placed at a distance of from three to five feet from the tube, and the proper exposure is learnt by experiment. The flowers, leaves, berries, insects, or small animals are placed upon the envelopes, care being taken that the emulsion side of the plate is uppermost and the tube is placed over the center of the plate.

A specimen plate was produced by placing the tube a distance of 3 feet 6 inches from the photographic plate. A twelve-inch coil with a mercury jet interrupter was used. Six amperes from a direct 220-volt supply was passed through the primary, a resistance of about 12 ohms also being used. The exposure was 90 seconds. The negative was developed with a hydroquinone-metol developer, the development taking about 10 minutes.

Should the flower or other object to be radiographed be of extremely fine texture, it is well to increase the distance between the plate and the tube. In radiographing insects no envelopes should be used, as the grain of the paper is apt to obscure some of the fine details which would be visible without them.

X-ray photograph of carnations, tulips, and daisies.

Stereoscopic radiographs may be obtained by first placing the tube 1½ inches from the central line to the right, and in the second case the same distance to the left. The ordinary stereoscopic changing box does not allow the necessary soft rays to reach the photographic plate.

X-ray photographs of anemones.

Micro-radiographs can also be obtained, and Dr. Hall-Edwards hopes shortly to place on the market a simple device for obtaining these with the minimum of trouble and expense.

Inasmuch as these radiographs show the internal structure of flowers, insects, and other objects in addition to their outline, they open up a great field for research. Their use largely dispenses with the need for dissection, while the periodic radiographing of a growing plant or small animal opens up a field of great value to the naturalist.

A Human Skeleton One Hundred and Fifty Thousand Years Old

DR. HANS RECK, of Berlin, has discovered, at Oldoway, in the north of German East Africa, the skeleton of a man who lived, in all probability, some 150,000 years ago. The photographs reproduced were supplied by the Doctor to the *Illustrated London News* and were accompanied by a note to the editor of that weekly. The following translation is from the German:

The rare animal fossils of the Tertiary Period yielded by Africa decided the Geological-Palaeontological Institute and Museum of the University of Berlin to excavate the Oldoway "pit." In three months, some 1,700 bones were found and taken to the expedition's camp, there to be sheltered carefully under primitive, straw-roofed huts until they could be numbered, classified, and packed for their long journey. The huts in question were full of bones and huge relics of elephants. Most of the tusks discovered were surprisingly long, very light, and straight. The best was 3.8 meters (10 feet 5 inches) in length. Then there were represented the rhinoceros, the hippopotamus, numerous antelopes and gazelles, as well as pigs, rodents, and beasts of prey.

It was frequently difficult to obtain the bones. Not only was there a dearth of water and a blazing sun, but wild animals would arrive unexpectedly and disturb the diggers. Rhinoceroses, in particular, chased the men from time to time, sending them running through the trees and holding them prisoners for hours. The crumbling walls of the pit provided another obstacle. A precious relic would be seen in about the middle of the 50-foot wall, and those seeking it would have to be lowered by ropes, or rude ladders would have to be made and so set that the "find" could be reached. When, by good fortune, a place was found upon which a man could stand, the task was easier, for the natural "platform" could be enlarged by the pick.

One day brought with it a great surprise. On the steep incline of the "pit," the excavators found signs of a human skeleton, which was soon laid bare and protected by a straw roof. The discovery was seen to be of extreme age, and in a remarkably fine condition. The stratum about it was undisturbed, proof that it owed its position not to having been buried at the bottom of a hole dug down through several strata, but to having been contemporaneous with the stratum in which it rested. And that stratum is so old geologically that the skeleton must date at least from the Diluvial Period of Africa, which, it may be noted, synchronizes with the Ice Period of Northern Europe. No more precise date can be assigned to it until it has been compared with fossils found during the same excavations. It is typically negroid, and the first fossil human form found at Oldoway. The skull is highly developed, narrow and long; the head is set deep in the shoulders; the chest is massive. The position of the skeleton calls for notice. The legs were drawn up sharply, and obviously in a natural manner. This is additional argument in favor of the belief that the body was not buried; and must be taken in conjunction also with the facts that there are no traces of entombment, and that the contorted attitude is unknown in any case of burial by man. It would seem that the man was driven into the lake which was once above the spot on which his remains were found, or met with an accident on it, and was drowned. The body would be quickly covered with the mud at the bottom of the water and tufa, and so be protected from disturbing influences.

By courtesy of the *Illustrated London News*.

The human skeleton found at Oldoway by Dr. Reck has already caused some controversy in Berlin. The skull is well developed; indeed, is like that of a negro of to-day. For this reason, more particularly, the age of the remains is being much discussed.

By courtesy of the *Illustrated London News*.

Dr. Reck thinks that the position of the Oldoway man is accidental, and not due to burial. Prof. Fritsch, on the other hand, states that the tufa bed in which the skeleton was found may have been there first, and the body may have been buried in it.

The skeleton of a prehistoric man found at Oldoway, German East Africa.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Road Construction by the "Penetration Method"

IN the "penetration method" of road construction a permanent foundation is first laid, after which large crushed stone is applied according to the road specifications. A "hot road oiler" is then run over the road, applying a hot bituminous binder, which is forced into the layer of crushed stone under pressure, filling up the interstices between the stones, and holding them in place. As the binder hardens, the stones are held more firmly in place, forming a solid mass of crushed stone and bituminous material. When the first course is finished, another layer of stone is rolled into place, the stones coming in contact with each other by the pressure of the steam roller; again a hot binder is applied by the "hot road oiler," filling up any crevices. In this way a solid road is obtained with no openings between the stones, and no moisture can get into the road and disturb its surface when it freezes, as is frequently the case in macadam roads. The stones are gripped in the bituminous binder, and all spaces filled up, so that the stones cannot be picked out by automobile traffic. Of course, a road of this type has no dust.

The machine here illustrated is specially constructed to deliver the hot bituminous binder under pressure. It is a 5½-ton truck, having sliding gear transmission with wide ranges of speed. The main tank holds 750 gallons of binder. The binder in the tank is heated by coils of pipe in the tank, which coils are filled with steam. This steam is generated in the flash boiler at the rear of the truck. The boiler is fired by fuel oil, which is carried in a small tank on the right-hand side of the truck, and hence invisible in our illustration. The steam from the boiler is also used to run a reciprocating "plunger type" air compressor. The air pressure forces the binder in the large tank into the road. A second small tank on the right-hand side of the truck carries the water for the boiler. The boiler is also provided with an air primer for starting the fire underneath the boiler.

Suitable arrangements have been provided for straining the binder when it is taken from the tank, before reaching the distributing manifolds situated underneath the boiler at the end of the truck. The operator is stationed at the rear of the truck, directly above the manifolds, so that he can control and regulate the application of the binder to the road. Provision is made for attaching a nozzle and hose to the distributing manifold and applying the oil locally by hand.

It can readily be seen that a full range is reached for the application of binder, by varying the air-pressure on the tank, by opening and closing the manifold nozzles, by varying the temperature at which the binder is applied, and by running the truck at different speeds. Binder can be applied at the rate of from ¼ gallon per square yard to as much as 2 gallons per square yard.

Marvelous Growth of the Motor Truck Industry

OF course we all know that the motor truck industry has shown a remarkable development in the past few years. There is plenty of evidence of this, not only on the streets of our large cities, but on the country highways. Nevertheless, we believe that a picture of this growth will startle even the most observant man.

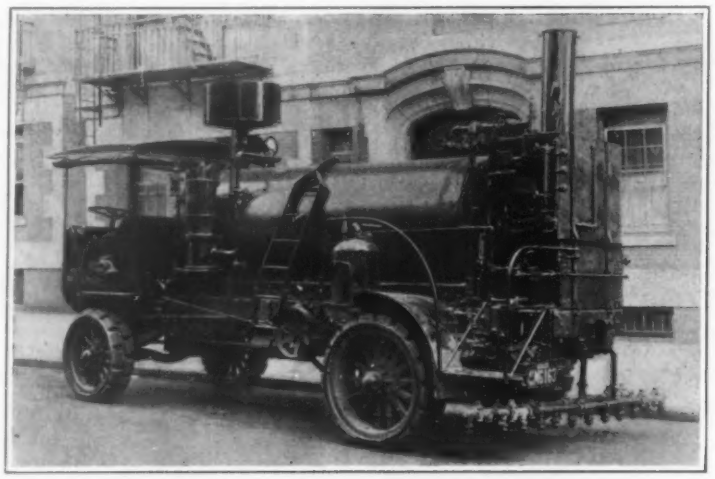
According to statistics published in the *Power Wagon*, there were, in 1910, 11,000 commercial motor vehicles. The next year the number had grown to 20,000. Thereafter the figures more than doubled each year. The year 1912 ended with 45,000 motor trucks, and last year the final figure rose to 95,000.

This geometrical progression cannot go on forever or in the next few years there would be more commercial than pleasure vehicles in service, and another decade would find more motor trucks than people in the United States. But as yet there appears to be no checking of the phenomenal growth. So far 1914 appears to be holding its own. Already the number has reached 125,000, and that for only a third of the year, viz., to May 1st.

We have endeavored to picture this remarkable increase by letting one vehicle represent ten thousand. Then the growth year by year is, roughly, as shown in the accompanying drawing. It will be noted that 1912, 1913, and 1914 have each half a truck to their credit that is not shown in the drawing.

Quoting again from *Power Wagon*, New York has 8,900 motor trucks in service, and Chicago 4,300, while third position is held by Los Angeles, which in three years has jumped from eighth position, with 300 trucks, to third position, with 4,000. Philadelphia holds fourth position with 3,000 motor trucks.

Most significant has been the progress in the use of "fleets" of trucks. There are now 149 concerns using 20 or more trucks, and of these twenty-two operate "fleets" of 100 or more. Among owners of five or more trucks department stores lead, with 2,753 machines; express companies come second, with 2,040 machines; and brewers third, with 1,543 machines. In actual numbers of trucks, furniture, hardware, and other trades lead, although they do not use as many trucks in fleets.



Machine for applying hot binders under pressure in road construction.

Pintsch Gas Residue for Motor Fuel

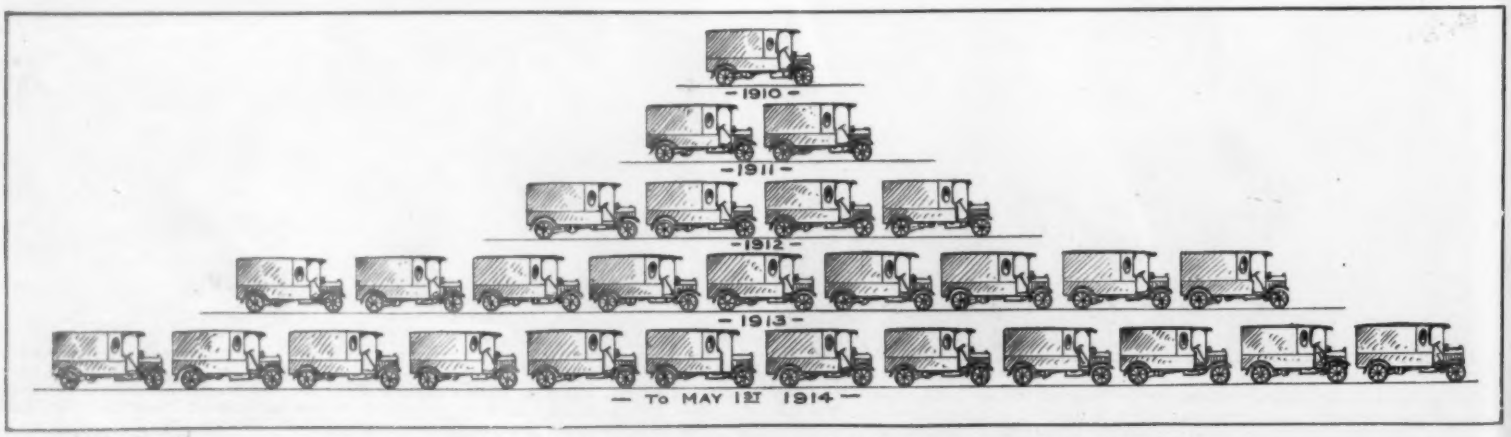
WHAT with the comparatively high price of gasoline anything that holds even the remote promise of taking the place of that commodity quite naturally is of interest to users of heavy motor vehicles, and in this connection the experience of a prominent gas company in Texas should prove doubly interesting, for the company has succeeded in using with its own vehicles a kind of fuel that never has been used before. The company in question is a large producer of Pintsch illuminating gas for residences and railroad trains and until very recently had considered it quite a problem to be rid of the great quantities of residue which accumulate. Previously, this residue, which is brownish in color and a hydro-carbon in nature, had been permitted to flow away and mingle with the waters of a large river. Now, however, a way has been found not only to use the residue, but to materially reduce the expense of operating the company's heavy trucks as well. The residue is passed through a small still and collected as a slightly lighter and colorless liquid. This liquid then is mixed with half its volume of commercial petroleum, the resultant compound costing the company all told 11 cents a gallon. In using the compound the ordinary gasoline carbureter is used and no need has been found for making adjustments of either fuel or air supply. Some slight carbonization results from the use of the fuel, but as this is a light, flaky deposit, it is of small consequence and blows away easily through the exhaust pipes. In starting during cold weather slight difficulty also is experienced by the drivers, though this is overcome by "spinning" the motor rapidly. It is stated that the company not only uses the new fuel itself for all of its vehicles, thus effecting a material economy in operating expenses, and, incidentally, obtaining considerably more power, due to the greater number of heat units contained in the fuel, but that it is producing it in limited quantities for the use of others. It is expected that other producers of Pintsch gas also will make some attempt to turn their unprofitable residue into profit as a result of the experiment of the Texas company.

Motor Truck Notes and Queries

L. G. V. writes: "What devices are there on the market intended to prevent the theft of a motor car or truck? Our delivery car is driven by one man who often has occasion to leave the machine standing for 15 or 20 minutes while he enters an apartment building to receive the day's orders. There have been several thefts of automobiles reported recently in our city, and as our car consists of a new chassis of the pleasure type with a panel body mounted thereon, it would make as valuable 'pickings' as would a high-grade touring car."

A. Nearly every new car is provided with a certain form of plug or lock and key that cuts off the ignition current. If a plug is ordinarily used, its place may be taken by a nail or cotter pin of the proper size, while the ordinary ignition lock is guarded only by a "blank" key or one that can be easily duplicated. Consequently, neither of these means is especially efficient against the experience of an automobile thief. Especially designed ignition locks are made, however, in which a famous type of burglar proof tumbler lock must be opened with

(Concluded on page 526.)



Motor trucks more than double their numbers each year. Each truck here represents ten thousand.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT.—B. I. FLIGEL, 410 E. 12th St., New York, N. Y. The invention has for its purpose the provision of a garment, such as a rain coat, cloak, and the like, and provided with a convertible collar and hood arranged to permit its use as an ornamental collar or as a hood, with or without a military effect.

GARMENT FORM.—E. T. PALMENBERG, 710 Broadway, New York, N. Y. This inventor provides a form arranged to provide a cushion between the body and the stand, with a view to prevent the lower end of the body from striking the base of the stand, to the detriment of the body in case the fastening device for fastening the body to the stand is loosened.

Electrical Devices.

ELECTRIC LAMP SOCKET.—M. REICH, 511 W. 56th St., New York, N. Y. This improvement reduces the labor of installing an electric lamp socket; enables an operator to install the socket in service position; simplifies the construction and mounts the socket readily in service position.

Of Interest to Farmers.

AUTOMATIC HEN MARKER.—F. H. PREBLE and K. D. GRANT, 2230 S. 22nd St., Philadelphia, Pa. This invention provides a nest construction with devices whereby, when a hen enters the nest, a drop of ink or paint of any suitable nature will be caused to drop upon her back. By this means, the hens which enter nests will be marked, so as to clearly identify them and distinguish them from the hens which do not frequent the nests.

PICKER'S SACK.—A. H. LARRABEE, Corona, Cal. The primary object here is to provide a top for a sack, which will keep sticks and trash from falling into the sack during the picking operation. An object is to provide a sack which is so constructed as to render it impossible for a picker to clip fruit directly into the sack, thereby injuring the fruit by the fall.

Of General Interest.

NON-REFILLABLE BOTTLE.—W. W. SMITH, address Stanley S. Spencer, Darlington, Md. An object of this invention is to provide a receptacle for holding liquids from

NON-REFILLABLE BOTTLE.

which the liquids may be readily poured, but into which the liquids cannot be readily returned after it is once emptied. The device is cheap to manufacture.

SEA-ANCHOR.—F. ROUSE, 2702 Hyde St., San Francisco, Cal. This invention provides a spreading frame for an anchor adapted to maintain its operative position irrespective of added weight; provides a buoy for said anchor to maintain the equilibrium thereof; and provides oil and a ballasting compartment adapted to hold and distribute a liquid to affect the surface of the water in which the anchor is held when in service.

CALCULATOR OR ABACUS.—R. C. BENNETT, care of A. P. Bennett, 144 W. 37th St., New York, N. Y. This invention refers to counting elements known as abaci, and has reference more particularly to the frame structure, which comprises a member carrying the counting elements and provided with supports at the ends of such a shape that the said member is in normal position at all positions of the supports.

SUPPORT FOR NOTE BOOKS AND THE LIKE.—J. WALKER, Augusta Works, 19-21 Warstone Lane, Birmingham, England. The invention provides the frame which carries the book with means for preventing accidental turning over of the leaves, with means for adjusting the same vertically and angularly in a horizontal direction, with means for adjusting the slope of the same, and with means, when it is used on a typewriter, for fixing it securely to the frame of any ordinary machine.

VENTILATOR.—J. A. HODEL, 3526 Sunnyside Ave., Falls of Schuylkill, Philadelphia, Pa. Mr. Hodel's invention relates to ventilators of the type used upon the tops of chimneys, flues, and the like, for the double purpose of preventing entrance of rain water into the chimney and of affording ready means for the escape of smoke from the chimney, while at the same time adding an ornamental appearance to the chimney top.

Hardware and Tools.

MICROMETER CALIPER.—E. W. MARION, 1833 Butler St., Philadelphia, Pa. This improvement has reference more particularly to a device which comprises a pair of relatively adjustable heads provided with measuring points, and means between the heads for altering the

MICROMETER CALIPER.

normal fixed distance between them. It provides a caliper with which measurements from zero to any number and fractional part of standard units, as machine practice may require, can be made by a simple adjustment of the parts.

Household Utilities.

UTENSIL KNOB.—E. C. FRISK and E. C. ANDERSON, Somerset, Wis. Address the former, Somerset St., Croix Co., Somerset, Wis. The invention relates to knobs for use with cooking utensils and the like, and refers more particularly to a device which comprises a knob proper, fashioned from an elongated spirally-disposed member, and means for attaching said member directly to the utensil or body.

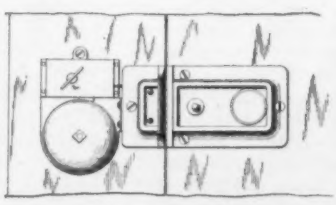
Machines and Mechanical Devices.

ALARM WATCH.—J. S. DEWITT, 306 N. Arthur St., Pocatello, Idaho. The more particular purpose here is to provide a watch with means for mounting it upon a person's wrist or ankle and providing said watch with additional means for producing a gripping or squeezing effect upon the wrist or ankle, for the purpose of attracting the attention of the wearer, and thus serving the purpose of an alarm.

APPARATUS FOR MANUFACTURING ICE.—L. C. BOND, Box 241, Beaufort, Charleston, S. C. This invention provides an apparatus whereby clean ice can be manufactured from water containing impurities in suspension. This is attained by providing moving receptacles adapted to receive the water to be frozen and positioned in the brine tank, the temperature of the brine being maintained below the freezing temperature of the water.

MATRIX MARKING MACHINE.—W. A. HEIDEL, 427 Jackson St., Mankato, Minn. This invention provides for recording matter to be printed and preserving a paper record of such matter, to be used as a matrix from which slugs may be made; simplifies the type bar mechanism so that a number of independent type bars may be lowered to different levels, each type bar carrying a plurality of type, the parts so arranged that the letters to be printed in a line are brought together by virtue of the levels of the several type bars; provides mechanism for restoring the type bars to a predetermined level; provides for properly aliuing and clamping type to enable them to make an impression in the printing of a line; and improves the mechanism for holding the type characters in position for making impressions. The machine may be produced at a very nominal cost.

ALARM.—J. RICHMAN, 570 Ralph Ave., Brooklyn, N. Y. This alarm is more especially designed for use on doors and arranged to sound an alarm when a person pushes the locked door. For this purpose use is made of an alarm device provided with an escapement



ALARM FOR DOORS.

wheel and an escapement lever, and a locking and releasing device for the said lever to normally lock the same against movement, the said locking and releasing device being adapted to be engaged by the door bolt when the latter is in closed position.

HOOD FOR TYPE WRITING MACHINES AND THE LIKE.—M. W. POTTER, Red Lodge, Mont. This invention relates to a collapsible hood to constitute a protective cover for typewriting machines and the like, and particularly to a hood comprising a flexible covering, and a framework including a series of separate foldable bows to maintain the cover in distended form, or to collapse the cover.

CRULLER SHAPING MACHINE.—I. HEINZ, 553 W. 48th St., Manhattan, N. Y., N. Y. The object here is to provide a machine which will automatically shape dough fed into the machine in a predetermined shape, as, for example, a cruller, and deliver the shaped dough; further, in shaping the dough by the machine, all waste of dough is eliminated.

STOP MOTION.—K. SLOAT, care of Scranton Silk Machine Company, Scranton, Pa. An improved stop motion is provided by this invention for use on reeling machines to stop positively and quickly the reel in case of the breaking of a thread or yarn or the running out of the yarn from its spool. The device requires no fine adjustment or sensitive balancing by skilled workmen, and the parts are prevented from being actuated by mere vibration incident to the running of the machine.

Railways and Their Accessories.

RAILWAY CAR.—J. W. SPAUR, care of Emmet Carey, Philipsburg, Mont. This inventor provides a construction of cars whereby the car ends will be disposed at an oblique angle transversely of the track, and hence upon a collision, the cars will not tend to telescope with the ordinary form of car, but by reason of the car ends being disposed in substantially parallel relation and obliquely with respect to the track, will tend to be thrown to one side of each other as they come together by impact of collision.

SWITCH LOCK.—J. D. MOORE, Folkston, Ga. The purpose here is to provide an arrangement which will effectively hold the switch point against the main rail and which may be readily released when it is desired to open the switch by connections of such character as that they may be actuated when the switch throwing lever is raised.

AUTOMATIC WHISTLE.—G. R. DUNN, R. F. D. No. 6, Elkhart, Ind. This invention provides means which may be disposed alongside the track for operating the whistle independently of any attention on the engineer's part. It provides means for automatically operating a whistle which may be disposed at predetermined points, so as to insure the sounding of the whistle at these points.

Pertaining to Vehicles.

AMBULANCE AUTOMOBILE.—F. E. CAMPBELL, 241 W. 23rd St., New York, N. Y. This invention provides means for, at will, converting an automobile of usual construction to adapt the same for use as an ambulance; provides an ambulance which may be arranged for the introduction of a stretcher without forcing the persons carrying it to step into the street; provides means whereby patient and stretcher may be introduced sidewise into an automobile, and thence moved across the body to provide a passageway for passengers entering the same side of the automobile; provides an extension to the automobile body for holding a portion of the person of a patient; and provides means over which the stretcher may be moved in depositing the same within the automobile body.

LOCKING DEVICE FOR AUTOMOBILES.—J. J. MEYER, 366 Lenox Ave., New York, N. Y. An object here is to provide a device for automobiles to prevent theft thereof by preventing unauthorized persons from running the automobile. A further object is to provide a device which can be readily carried about and easily applied, even in the dark.

SIGN.—L. GOTTSCHOLL, 462 Broadway, New York, N. Y. This sign is for use on automobiles and the like to display a license number or other distinguishing marks which can be distinctly read, which are visible at night for a great distance, and which greatly aid the eye in detecting the number of distinguishing marks as well as aiding the memory in remembering the same.

MANURE CATCHER.—C. H. FERGUSON, 66 Lafayette St., Jersey City, N. J. This catcher is of the type adapted to be applied to horses while being driven through city streets, so as to prevent the dropping of manure in the streets, with the expense to the municipalities of cleaning the streets. It prevents the spread of diseases by manure dust in windy weather.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 9366. Wanted the name and address of a manufacturer of wire wheels, front axles complete with steering or separate, light sheet metal bodies, fuel tanks with cocks, pressed steel frames, mufflers, motors of the two-cylinder opposed type, cushions and many smaller parts for cycle cars.

Inquiry No. 9367. Wanted the name and address of a manufacturer of an automatic centering machine.

Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addresses of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

Inquiry No. 9373. Wanted the name and address of a manufacturer of machinery that will make twine out of scrap paper.

Inquiry No. 9374. Wanted the name and address of manufacturers of a powder paste which, when mixed with cold water, will make a white paste suitable for papering, costing no more than 3 cents per pound in ton lots.

Inquiry No. 9375. Wanted the name and address of the manufacturer of a separable fastener, invented especially for shoes and other articles.

Inquiry No. 9376. Wanted, the name and address of a manufacturer making clock-work mechanism for running window display machines as employed by safety razor manufacture.

Inquiry No. 9377. Wanted, the names and addresses of factories making farm implements for export.

Inquiry No. 9378. Wanted, the name and address of a manufacturer of smooth metal mirror frames, such as are sold in 5 and 10 cent stores, with a mirror and a cardboard back.

Inquiry No. 9379. Wanted, meteorites—information desired concerning available specimens.

Inquiry No. 9380. Wanted the name and address of a manufacturer of burners and handles for gas-heated sad iron.

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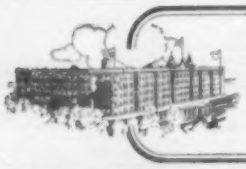

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Motor Truck Notes and Queries

(Concluded from page 524.)

the proper key before the current can be turned on. Locks of a similar nature are also provided to be installed in the fuel line. A third class of thief-proof automobile locks is intended to be placed in the gear-shift slot so that the transmission cannot be moved out of the neutral notch. It will be observed that all of these locks are designed solely to prevent the car from being moved under its own power, and it is hardly probable that the thief would take the machine in tow. Locks of this nature may be used on the car when it is stored in a public garage, for the truck can then be moved about by hand to make room for other machines, and yet it cannot be run under its own power without the owner's knowledge.

W. L. K. writes: "I remember the announcement of the manufacturer of a half-ton truck to the effect that his machine had hauled six or seven tons. As I understand that overloading is a practice universally condemned by reputable truck manufacturers, I should think such an announcement would do more harm than good to the industry in general."

A. If the conditions were exactly such as those cited, you are correct in assuming that great harm would be wrought to the truck industry. The load to which you refer was not carried directly on the half-ton truck, however, but was pulled, or hauled, by it in much the same manner as a locomotive draws a train of loaded freight cars. By the use of properly-designed trailers, a small truck may be made to do the work of several cars on a smooth level road, and the strain on the tires, springs, motor, and mechanism in general will be no greater than would be the case were a normal load to be hauled up a hill. A portion of the load should be carried on the truck in order that sufficient traction will be furnished to the wheels so that they will not slip. A truck used in this manner is known as a tractor, while the trailer may be any form of vehicle not propelled by its own power. Special types of trailers have been manufactured to be used in connection with some of the low-priced pleasure cars so that the latter may be easily converted into efficient commercial vehicles.

P. J. N. writes: "An ordinance has recently been passed in our town prohibiting the use of the muffler cutout on motor vehicles. The man who drives our 3-ton truck uses the cutout almost constantly, and tells us that it is necessary in order to give him sufficient power for some of the steep hills. What shall we do if this proposed ordinance is enforced?"

A. It is probable that the driver of your truck shares the popular "superstition" to the effect that eliminating the muffler greatly increases the power developed by the motor. Tests have shown that, in certain instances, a poorly-designed muffler may absorb from 10 to 15 per cent of the power developed by the motor, but that this is only when the engine is working at its full capacity, and that, therefore, the cutout is never really necessary except when the car may be climbing a hill so steep that every ounce of energy is required from it. But the low gear is designed to furnish the proper reduction so that any hill may be climbed without the use of the cutout, and, therefore, its use must be an admission that the motor is in poor condition. We would suggest that you overhaul your motor thoroughly, clean the valves, remove the carbon, and, if necessary, install a larger and more efficient muffler.

The Challenger, "Shamrock IV," Under Sail

(Concluded from page 520.)

surface is not any larger in "Shamrock IV" than it is in the older boat.

It is stated that she has shown herself to be very stiff, too much so, in fact, for her own good when the airs are light. The centerboard is to be unshipped, and a recent dispatch says that about five tons of lead is to be taken from the keel. These changes, together with the double

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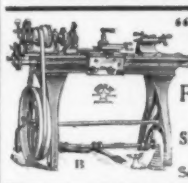

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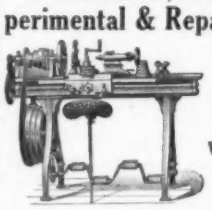

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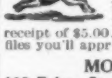

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head rig, should improve her average speed over a triangular course under light weather conditions. Furthermore, the removal of the steel centerboard and five tons of lead should reduce the draft of the "Shamrock" from 1½ to 1¾ inches. This, because of her shoal body, should shorten the water-line length by over a foot and reduce her time penalty.

Among our illustrations, the most interesting is that showing the method of stiffening the lofty, hollow, wooden mast of "Shamrock IV," the novelty consisting in a five-strut trussing, which is applied to the mainmast at about two thirds of its height, two of the struts extending athwartship, one projecting forward, and the other two at angles of 45 degrees. The "Shamrock" has been tried in strong winds, and is said to carry her lofty rig without any signs of weakness.

Saving Men from Submarines

(Concluded from page 516.)

siren is a plate covering a telephone transmitter, which can be broken by the rescue party, and communication thus established with the men imprisoned below. If the salvage operations are likely to take some time, arrangements can be made for passing liquid food down the air-pipe, as has been done in the case of miners buried alive under a fall of earth, but with whom communication has been established pending their being dug out. The inventor maintains, however, if his ideas are properly carried out, the crew would be able to stay at the bottom for a very considerable time, as the lockers under the seat in the cylinder are supposed to be kept stocked with provisions, in readiness for such an emergency, and there is a tank which is to be kept filled with fresh water. In one locker there is an electric battery, to give light to the imprisoned men, and in another is compressed oxygen, in case of need. There is also an inner chamber round the boat, filled with compressed ordinary air, which can be used if required. Round the fresh-water tank is another tank, in which sea-water can be admitted by a valve, to be used as ballast, if necessary, and this tank is also to be used as a lavatory and a means of keeping the boat pure and clean—a very important consideration if life is to be maintained for any length of time.

Science and the Tariff

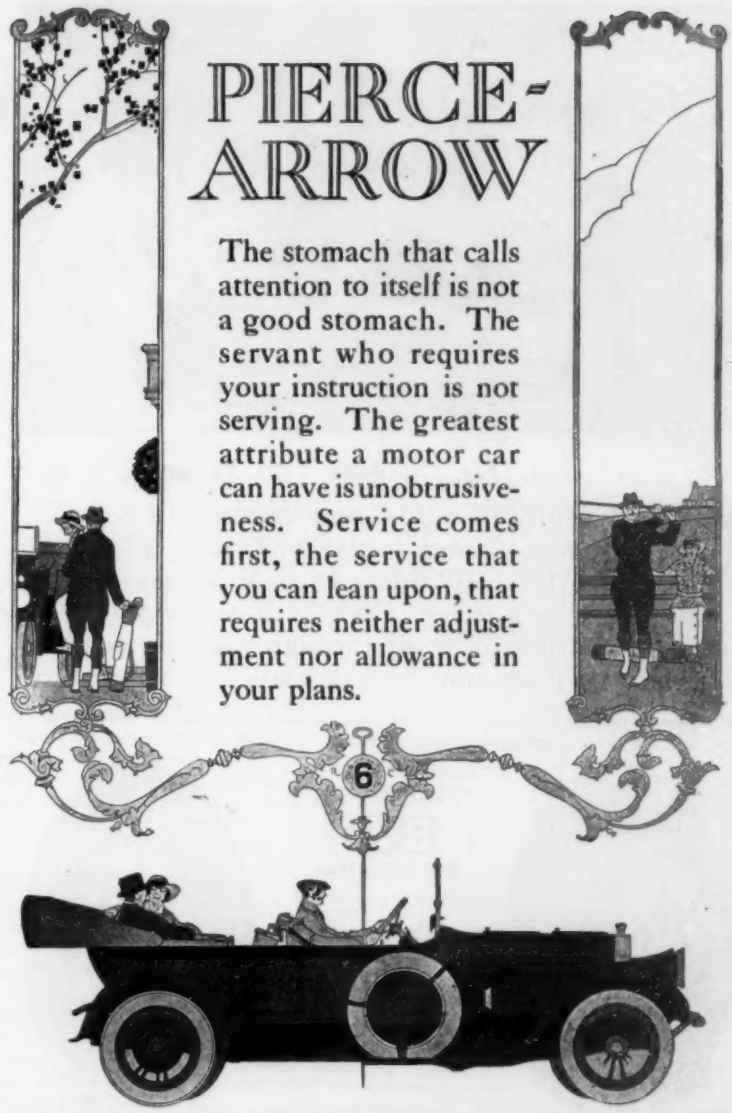
(Concluded from page 522.)

classification and assessment of customs duties on cotton yarn and cloth, due to variations in the atmospheric conditions, the Treasury Department has declared that "whenever the weight is found within 5 per cent of its given equivalent weight in the table it will be necessary to make further trials of at least four samples, and if the average weight is again found to be under 5 per cent, the sample must be conditioned; that is, dried to bone dryness, and a regain of 8½ per cent added back."

Bone dryness of the cotton yarn, or cloth, is a condition in which all moisture is expelled, and this is only accomplished by dryness to a constant weight in a circulating atmosphere at a temperature of 110 deg. Cent. The regain of 8½ per cent added to the bone-dry weight would give the weight of the cotton yarn, or cloth, as if it had been subjected to an atmospheric condition of about 70 deg. Fahr. temperature and 65 per cent relative humidity. The number of the yarn calculated on this weight would be the size of the yarn, provided it had been subjected for a sufficient period of time to these standard atmospheric conditions.

In order to determine accurately the bone-dry weight, the Treasury Department has recently installed in the U. S. Customs Laboratory, Appraiser's Warehouse, 641 Washington Street, New York, a type of a machine known as the Freas electric-conditioning oven. It is the second of its kind to be manufactured, the other one having been placed in the textile division of the Bureau of Standards in Washington.

The oven is built of heavy fireproof asbestos wool, with chamber size 12 inches



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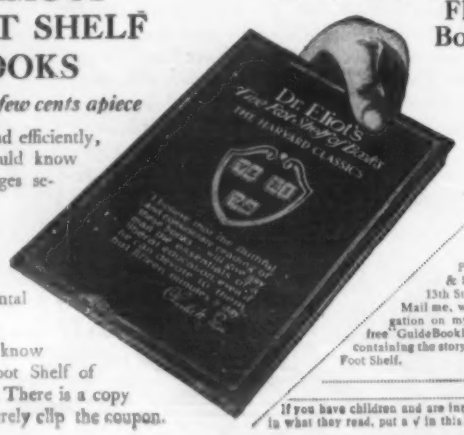

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by 12 inches by 12 inches. The frame of the door is made of heavy aluminium casting insulated with asbestos, and is provided with a double window (mica on the inside and glass on the outside), with drop shield, which permits of inspection of the oven without opening the door. Two small electric lights are placed in the upper inside corners of the chamber, and can be turned on or off by a switch-button on the front of the oven above the door. One of the lights is continuous, and serves as a source of illumination for the oven, and the other is intermittent, and indicates the making and breaking of the contact of the heat regulator.

To expedite the drying, the circulation of heated air supplied to the oven is artificially adjusted by means of a fan situated in the back of the chamber, and driven by a 1/15 horse-power motor, shunt wound, with a speed of 1,100, and a voltage of 110. Complete ventilation, to get rid of the moisture from the substance being dried, is obtained by two openings, or vents, one on each side of the back of the oven next to the bottom; these openings can be closed, or partially closed, by means of metal plates which fit over the openings, and are readily turned.

The heating element, which is wound with a high heat-resisting wire, is situated in the bottom of the chamber underneath a fire-clay plate which contains numerous holes for transmission of heat. The regulation device is fitted in a separate compartment made entirely of metal, and located above the chamber. Its action depends on the expansion of the metal tube through the chamber, operating a lever, which makes and breaks a contact, with proper means to prevent arcing. The lever is extended to serve as an indicator, operating up and down a graduated scale on the outside of the oven. The indicator is moved to the desired temperature by simply turning the knob screw at the bottom of the scale.

The oven is also provided with a double window (mica on inside and glass on outside), with drop shield, on the side of the oven, so as to permit operator to manipulate the horizontal rod with fastened hook for removing and returning baskets from carrier to connecting rod attached to one arm of the balance.

To the top of the chamber is fastened a four-armed horizontal metal frame. At the end of each arm is attached a small pulley, and on these pulleys moves an endless chain, similar to a bicycle chain. This chain is moved by a toothed wheel on the side of the chamber, which, in turn, is moved by a thumb-screw on the outside of the oven. Ten metal hooks are suspended from the chain, and to these are swung ten metal mesh baskets, each of which is 6 centimeters in depth by 4 centimeters in diameter. By the aid of the thumb-screw, the carrier can be turned, so as to bring the baskets into position under the balance to be weighed within the oven.

On top of the oven is an analytical balance of 100 grammes capacity and 1/10 milligramme sensibility, one arm of which is attached to a connecting rod which passes through an orifice into the oven. By turning the horizontal rod which traverses the rear of the chamber, the baskets can be removed from the carrier and attached to the connecting rod which passes into the balance. By moving the carrier the baskets can consecutively be brought in position and attached to the connecting rod. All the baskets are adjusted so that they weigh the same, and are equal to the counterpoise which is suspended from the other arm of the balance.

In the conditioning of the samples of yarns and fabrics weighing 1,000 grains and less, this oven possesses the following features that are superior to other conditioning ovens, both electric and gas, that are now used in the textile trade: (1) It occupies a small space, about three feet square; (2) a constant temperature within 1 deg. Cent. scale can be maintained; (3) ten samples can be conditioned at one time; (4) an analytical balance with a maximum load of 100 grammes and 1/10 milligramme sensibility can be used for weighing the samples within the oven.

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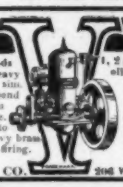

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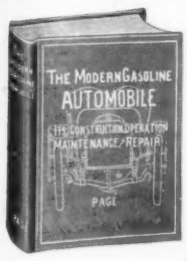

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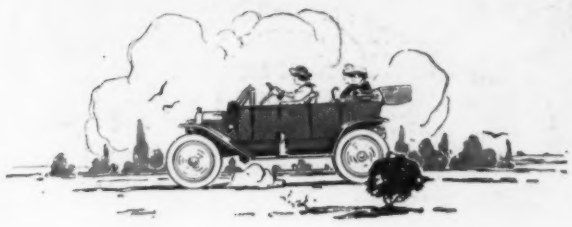
Your Ford Car

Why it should be lubricated with Gargoyle Mobiloil "E"



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These factors are :

(1) **Speed, Bore and Stroke.** Under the hood you have a small, high-speed motor. The Ford speed conditions demand oil of a different *body* from that demanded by low-speed conditions. The body of Gargoyle Mobiloil "E" meets this Ford need with scientific exactness.

(2) **Piston Clearance.** The Ford pistons are closely fitted. Each piston has two upper rings, and one lower ring and an oil groove. The lower ring tends to prevent a surplus of oil working into the combustion chamber, while the oil groove insures proper lubrication of the wrist-pin. Engineering tests show that the body of Gargoyle Mobiloil "E" forms the correct film for the Ford piston clearance.

(3) **Lubricating System.** The oil is supplied to the crank case. The connecting rods dip. All parts of the Ford motor are supplied by splash lubrication, requiring an oil which will atomize readily. Gargoyle Mobiloil "E" has the scientifically correct *body* to properly distribute to all friction surfaces.

(4) **Cooling.** The Ford motor is water-cooled by the Thermo-Syphon system, and is equipped with two forward speeds. The continued use of low gear often causes overheating. For full protection, oil should be used which distributes freely to the heated frictional surfaces, as Gargoyle Mobiloil "E" does.

(5) **Ignition.** The Ford system of ignition is by low-tension magneto, located in the fly-wheel, employing a four unit coil of the vibrator type. Gargoyle Mobiloil "E" will burn cleanly from ignition points—a most important consideration.

(6) **Bearings.** The Ford bearings are of the two-bolt type, brass with Babbitt lining, closely fitted. The correct *body* of Gargoyle Mobiloil "E" enables it to properly reach all parts of the closely-fitted bearings.

(7) **Carbon Deposit.** To insure the least carbon under all conditions, an oil should be used whose only deposit will be of a dry, non-adhesive character—easily and naturally expelled through the exhaust. Gargoyle Mobiloil "E," if the proper level is maintained, will deposit little if any carbon in a Ford motor.

(8) **Extreme Weather Conditions.** On hot summer days you will sometimes see Fords running under overheated conditions, often due to faulty lubrication. Ford owners who use Gargoyle Mobiloil "E" are free from this trouble, owing to the ability of the oil to absorb and radiate heat. On cold winter days oil is required of a fluidity which enables it to meet low-temperature conditions and permit ease in cranking the motor. Gargoyle Mobiloil "E" completely fills these requirements.

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